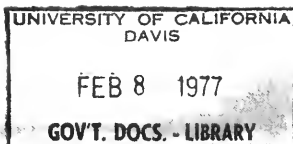


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Rainfall Analysis for Drainage Design Volume III. Intensity-Duration-Frequency Curves

Bulletin No. 195
October 1976

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16. Abstract This report is an analysis of depth-duration-frequency of precipitation in California and contains the annual series extreme values from about 30 rain gage networks in California. A statistical analysis of each record is available, giving 12 return periods ranging from 2 to 10,000 years and durations of 5 minutes to 60 days, including the annual total precipitation. Methods of interpolation are given. Hourly precipitation records of the National Weather Service were reevaluated to develop 5-, 10-, 15-, and 30-minute extreme data. This volume contains precipitation intensity-duration-frequency curves from 500 recording rain gages, based on maximum annual rainfall depths for 5 to 180 minutes. The information contained in this report is intended for use in runoff computation using procedures such as the rational method or the unit hydrograph method. A cooperative computer data bank has been developed to store data on rainfall extremes and to periodically analyze data, as well as to maintain a continuous file for future use by cooperators.			
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**Department of
Water Resources**

Bulletin No. 195

Rainfall Analysis for Drainage Design

**Volume III.
Intensity-Duration-Frequency Curves**

October 1976

Claire T. Dedrick
Secretary for Resources

Edmund G. Brown Jr.
Governor

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Director

**The Resources
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**State of
California**

**Department of
Water Resources**

OTHER VOLUMES OF BULLETIN NO. 195
(Bound separately)

Volume I. Short-Duration Precipitation Frequency
Data

Volume II. Long-Duration Precipitation Frequency
Data

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Kern County, Department of Public Works and County Surveyor
Kern County Water Agency
Los Angeles County Flood Control District
Marin County, Department of Public Works
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Monterey County Flood Control and Water Conservation District
Orange County Environmental Management Agency
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Riverside County Flood Control and Water Conservation District
Sacramento County, Department of Public Works
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San Bernardino County Flood Control District
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San Francisco, City of, Sanitary Engineering Department
San Luis Obispo County, Engineering Department
San Mateo County, Department of Public Works
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Santa Clara Valley Water Conservation District
Santa Cruz County, Departments of Public Works and Health
Shasta County, Department of Water Resources
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U. S. Bureau of Reclamation
U. S. Forest Service
U. S. Geological Survey
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U. S. National Weather Service
Ventura County Flood Control District
and many private individuals



Typical modern tipping bucket rain gage
Photo by Weather Measure Corp.

INTRODUCTION

Bulletin No. 195, *Rainfall Analysis for Drainage Design*, is published as three separate volumes that complement one another but may be used independently, as well. Volume I contains short-duration precipitation data. Volume II contains long-duration precipitation data. This volume, Volume III, presents intensity-duration-frequency (IDF) curves for stations with data for precipitation periods of 5 minutes to 24 hours.

The IDF curves are arranged first by county, second by watersheds within each county, and then alphabetically by station name. The drainage basins are depicted on Plate 1. Individual station locations are plotted on Plate 2. Mean annual precipitation is shown on Plate 3.

The data in this volume consist of annual extremes of rainfall for durations of 5 to 180 minutes (reported in Volume I, along with the analysis on which the curves are based). This information is necessary to the design of culverts, spillways, and other drainage facilities. The sizes of such structures are determined by many factors, including the expected rainfall intensities associated with given return periods. These curves have been developed specifically for culvert designers of the California Department of Transportation who need data on rainfall intensity to estimate runoff at culvert sites. The curves are planned for use with simple runoff models, such as the rational formula:

$$Q = 1.008 CiA \quad (a)$$

where Q = peak runoff in cubic feet per second

C = runoff coefficient, ranging from "0" for no runoff to "1" for runoff of all rainfall

i = rainfall intensity in inches per hour

A = area in acres

Rainfall intensities are inversely proportional to time; the shorter the period of time, the higher the intensity. Therefore short-duration rainfall is the most critical in culvert design. Short-duration rainfall extremes can be estimated by use of the following equation:

$$I = \bar{P}T^N \quad (b)$$

where I = design storm intensity, in inches per hour

\bar{P} = mean one-hour storm, as a fraction of MAP, in inches

T = time in hours

N = slope of the log-intensity/log-line plot

Design rainfall for various return periods can be developed from the following equation:

$$I_j = \text{MAP } \bar{P} (1 + K_j \text{CV}) \quad (c)$$

where j refers to return period

I_j = precipitation intensity for return period j

MAP = mean annual precipitation, in inches (see Plate 3)

\bar{P} = mean one-hour storm, as a fraction of MAP, in inches (see Plate 4)

K_j = frequency factor (see Table 1)

CV = coefficient of variation (see Figure 1)

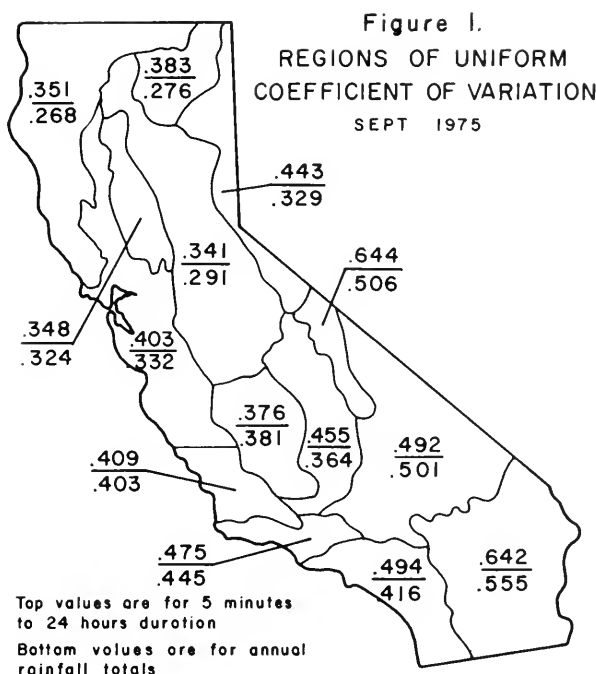
Combining equations (b) and (c) yields the equations of the IDF curves of Volume III:

$$K_j = (\text{MAP}) (\bar{P}) (1 + K_j \text{CV}) T^{-n} \quad (d)$$

K_j is the only value representing different return periods; therefore, the lines on the IDF curves are parallel. The distance between the lines are a function of CV and K_j only. The slope of the IDF curves represents the ratio of short-duration design storms to storms of longer duration

The length of the time period used in a specific application depends on the "time to peak", or time of concentration, which is unique to each watershed. The broad ranges of time represented here are suitable for all but the smallest watersheds. Rooftop and bridge surfaces frequently need data for durations shorter than 5 minutes. No adequate data are available for storms of that duration at the present time; however, estimates of such durations can probably be made from a straight line extension of the IDF curves in this volume.

In some cases, there was no information on one or more of the seven durations of 5, 10, 15, 30, 60, 120, and 180 minutes. Where this has occurred, only those durations that were available were used in this analysis. The durations used are shown on the IDF curves by plotting the mean values just above the two-year return period values.



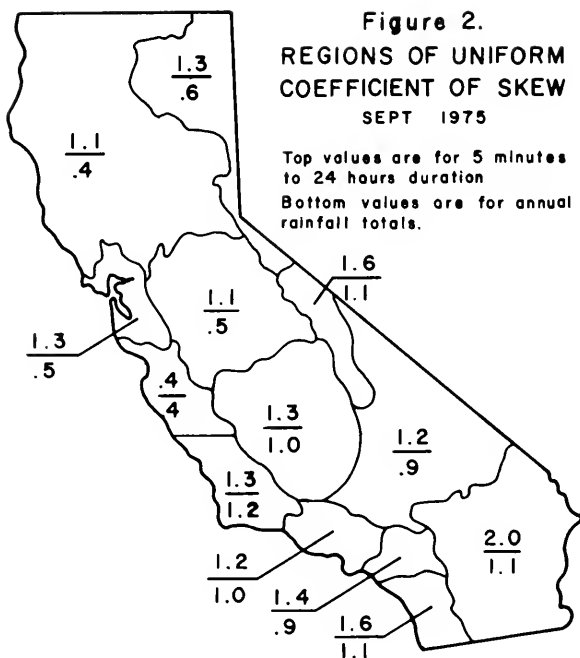
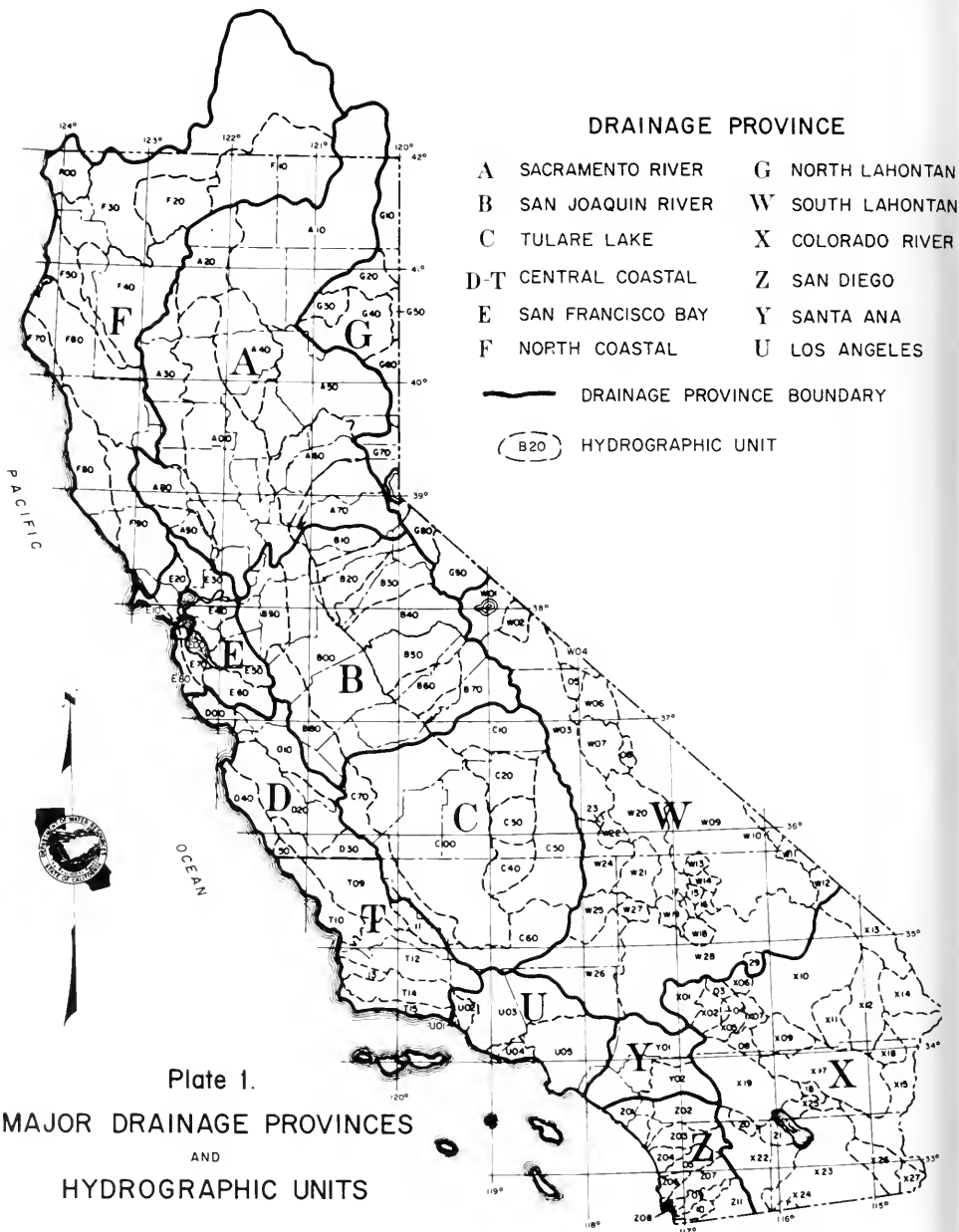


TABLE 1
FREQUENCY FACTORS FOR PEARSON'S TYPE III DISTRIBUTION

Return Period in Years	Coefficient of Skew																	
	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	
2	.07	.08	.10	.12	.13	.15	.16	.18	.20	.21	.23	.24	.25	.27	.28	.29	.31	
5	.82	.81	.80	.79	.78	.77	.76	.75	.73	.72	.71	.69	.68	.66	.64	.63	.61	
10	1.32	1.32	1.33	1.33	1.34	1.34	1.34	1.34	1.34	1.34	1.34	1.33	1.33	1.32	1.32	1.31	1.30	
20	1.75	1.77	1.80	1.82	1.84	1.86	1.88	1.89	1.91	1.92	1.94	1.95	1.96	1.97	1.98	1.99	2.00	
25	1.88	1.91	1.94	1.97	1.99	2.02	2.04	2.06	2.09	2.11	2.13	2.15	2.16	2.18	2.19	2.21	2.22	
40	2.14	2.19	2.22	2.27	2.31	2.35	2.38	2.42	2.45	2.49	2.52	2.55	2.58	2.61	2.64	2.66	2.69	
50	2.26	2.31	2.36	2.41	2.45	2.50	2.54	2.58	2.63	2.67	2.71	2.74	2.78	2.81	2.85	2.88	2.91	
100	2.62	2.69	2.76	2.82	2.89	2.96	3.02	3.09	3.15	3.21	3.27	3.33	3.39	3.44	3.50	3.55	3.61	
200	2.95	3.04	3.13	3.22	3.31	3.40	3.49	3.58	3.66	3.75	3.83	3.91	3.99	4.07	4.15	4.22	4.30	
1,000	3.67	3.81	3.96	4.10	4.24	4.39	4.53	4.67	4.81	4.96	5.10	5.23	5.37	5.51	5.64	5.77	5.91	
2,000	3.96	4.12	4.29	4.46	4.63	4.80	4.97	5.13	5.30	5.47	5.63	5.80	5.96	6.12	6.28	6.44	6.60	
10,000	4.60	4.82	5.05	5.27	5.50	5.72	5.96	6.18	6.41	6.64	6.87	7.09	7.32	7.54	7.77	8.00	8.21	



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Tiger Creek PH	33	Weaverville	267
Tonopah Nevada	312	Weideman Ranch RRNG	42
Topanga Pat Sta	85	Weldon 1 WSW	61
Trabuco Canyon	147	Wellington R S Nevada	292
Tracy 2 SSE	205	Westminster	145
Trinity Center	266	Westwood	75
Truckee R S	135	Wheatland 2NE	289
Tujunga Mill Creek	84	Wheeler Ridge	60
Tulelake	255	Wheller SP 2SSW	278
Tustin Automatic	144	Wheller Springs 7N	287
Twin Pines	155	Whiskeytown	252
United Technology C	242	White Rock Preston	114
Upland FC650B	191	Williams	38
Upper Franklin Res	107	Willits Howard R S	116
Upper San Leandro Filters	31	Winchester	162
Upper Toro Creek	210	Woodacre	81
Upper Tres Pinos	173	Woodcrest S D F	158
Upper Van Vlick SMUD	48	Wrights Lake SMUD	48
Valleton	130	Yorba Reservoir	138
Van Nuys	108	Yorkville	117
Venado	260	Yosemite N P	113
Ventura County Apt 168	283	Yucaipa Water Co	192
Victorville	179	Yuma Arizona AP NWS	295

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Plate 2 Sheet 1 of 5
Location of
RECORDING RAIN GAGES
June 1976

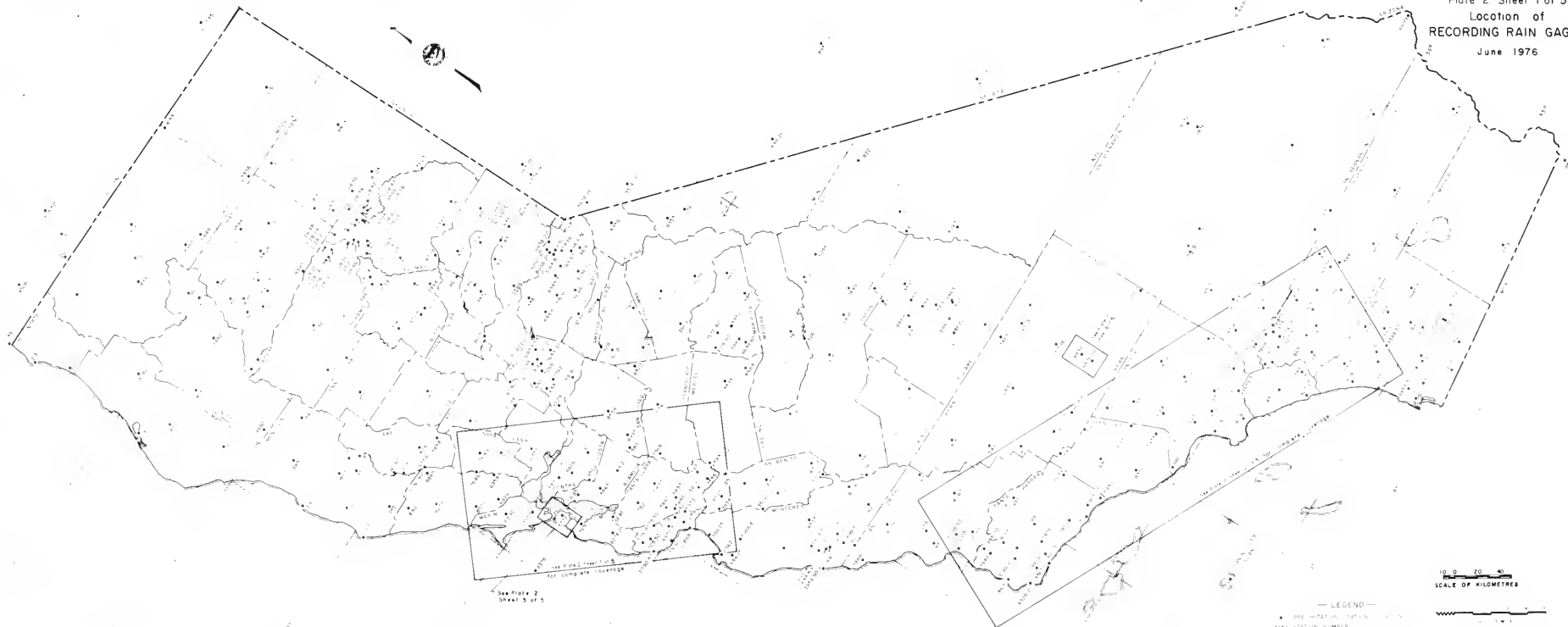




Plate 2 Sheet 2 of 5
Location of
RECORDING RAIN GAGES

June 1976

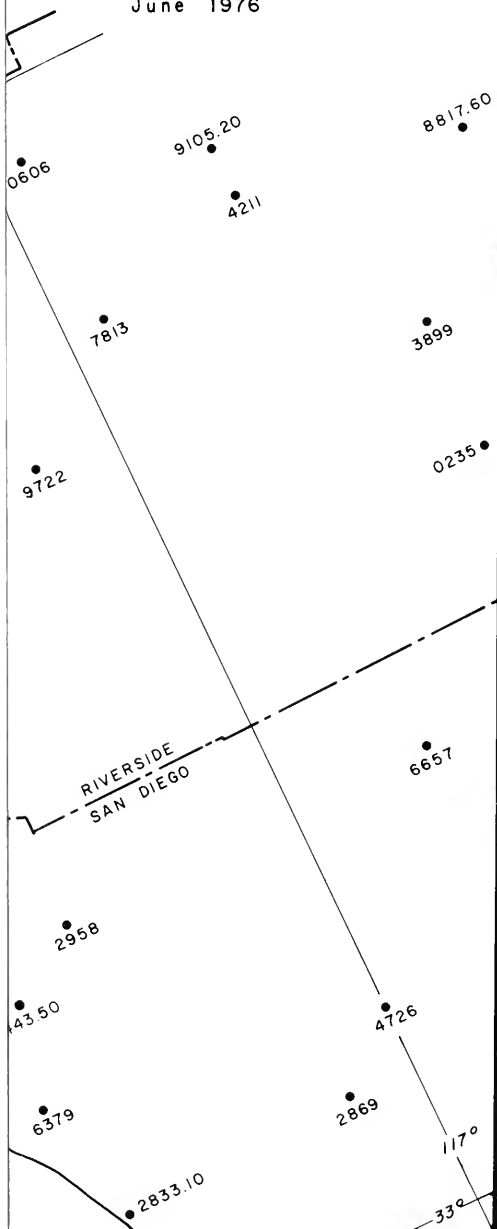
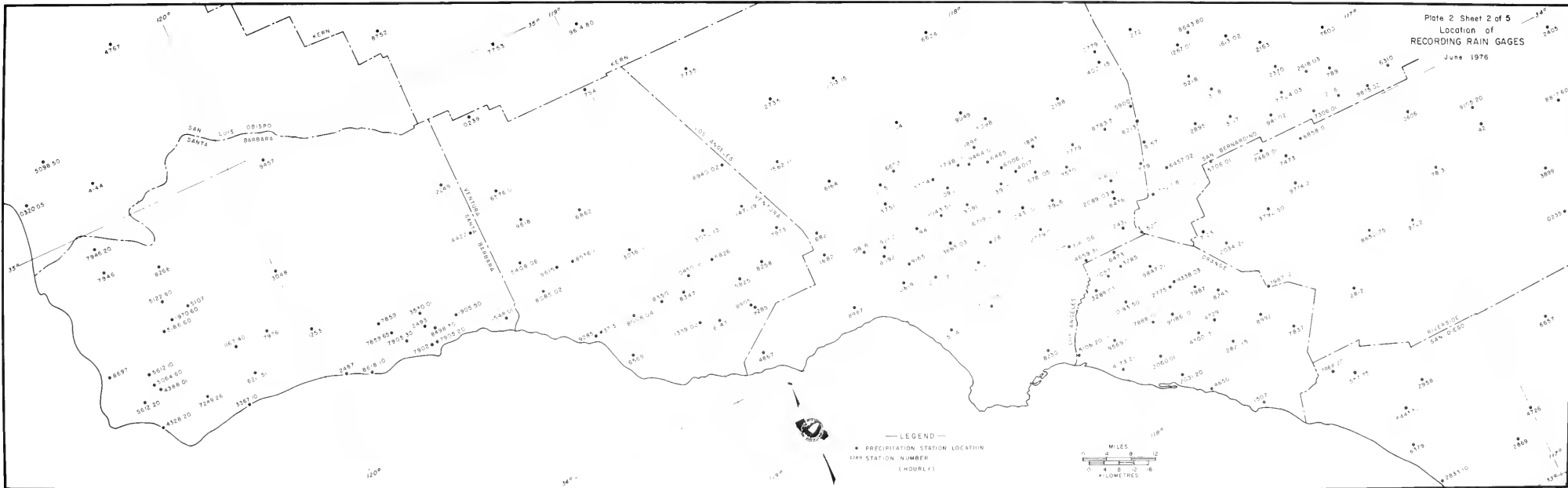
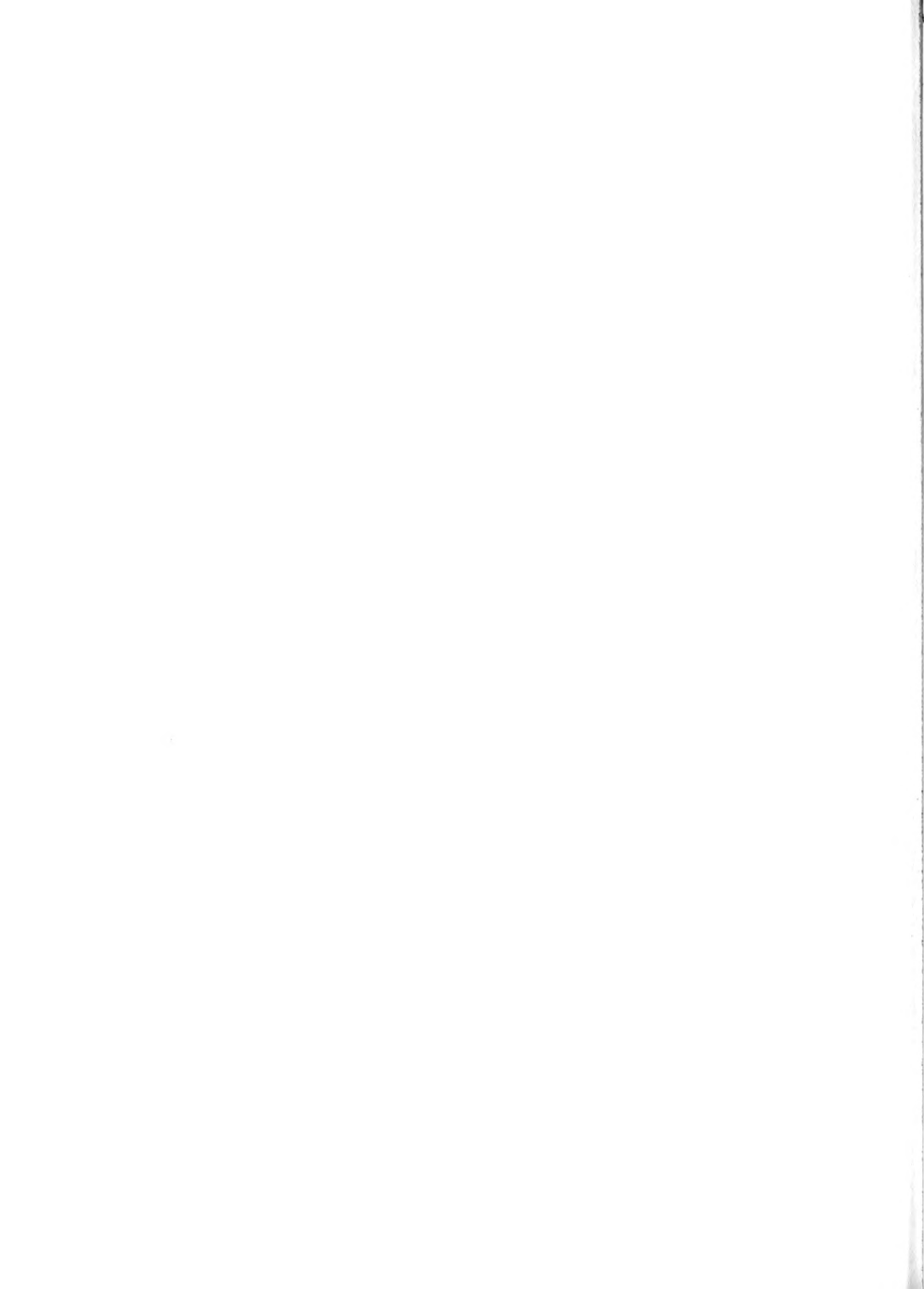


Plate 2 Sheet 2 of 5
Location of
RECORDING RAIN GAGES
June 1976





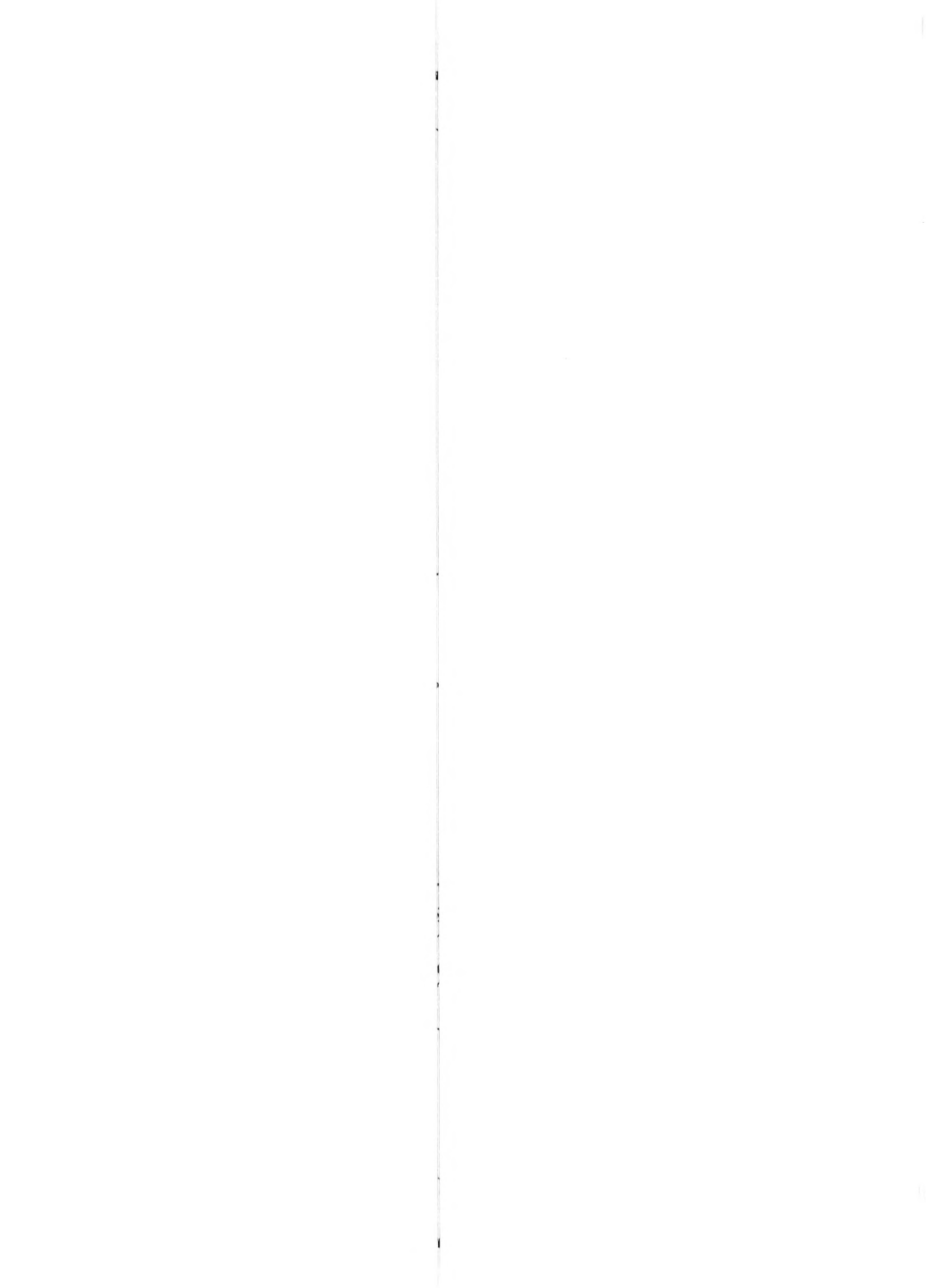


Plate 2 Sheet 3 of 5
Location of
RECORDING RAIN GAGES

June 1976

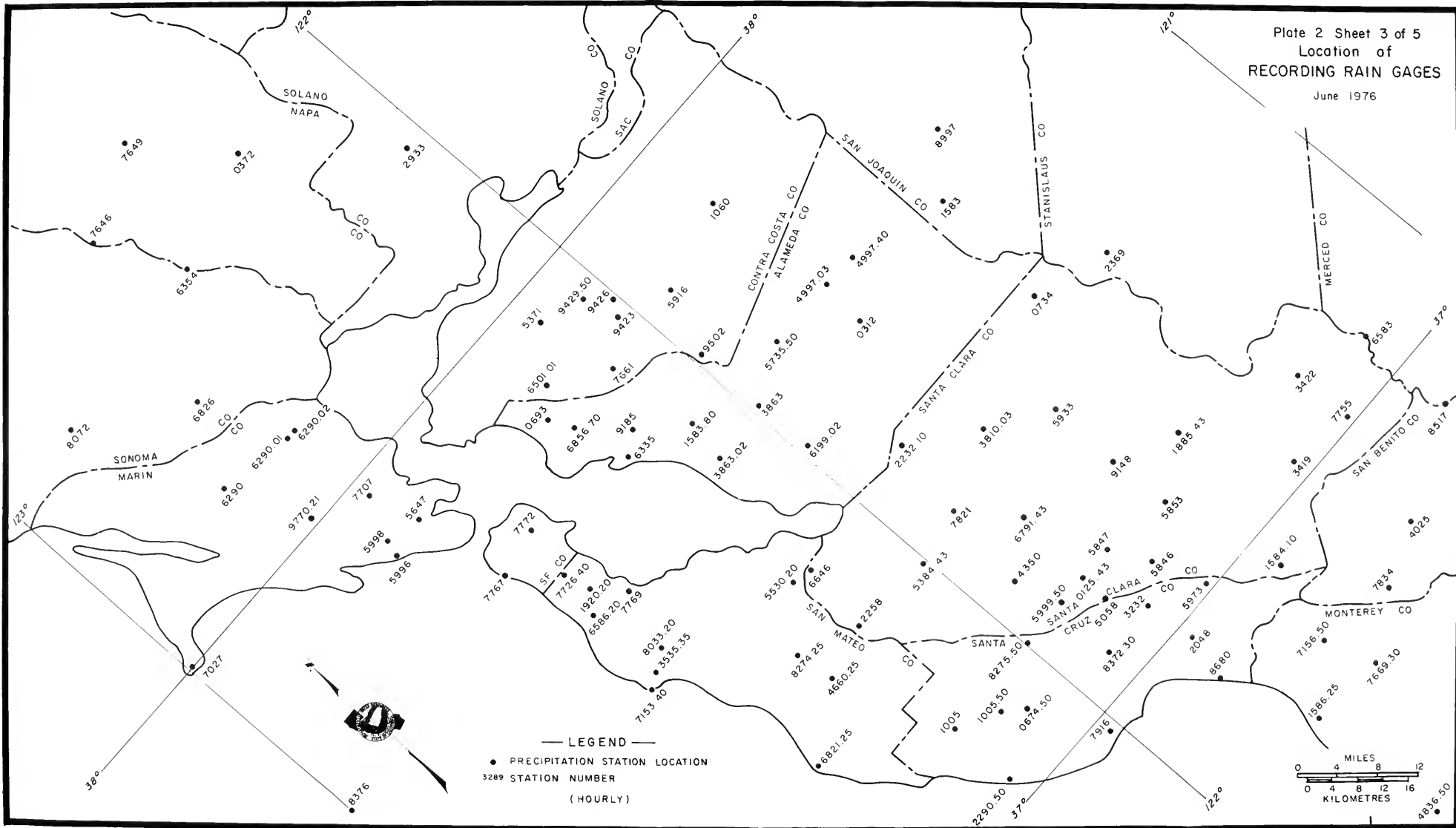




Plate 2 Sheet 4 of 5
 Location of
 RECORDING RAIN GAGES
 June 1976

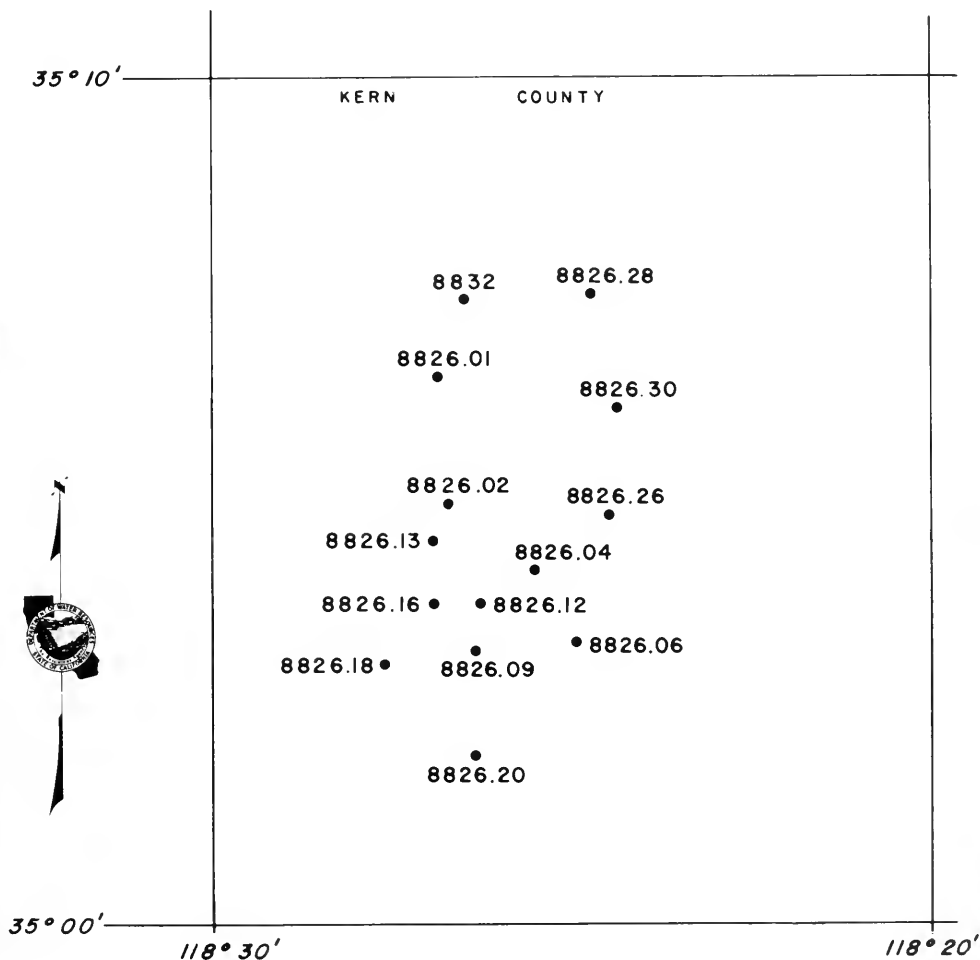
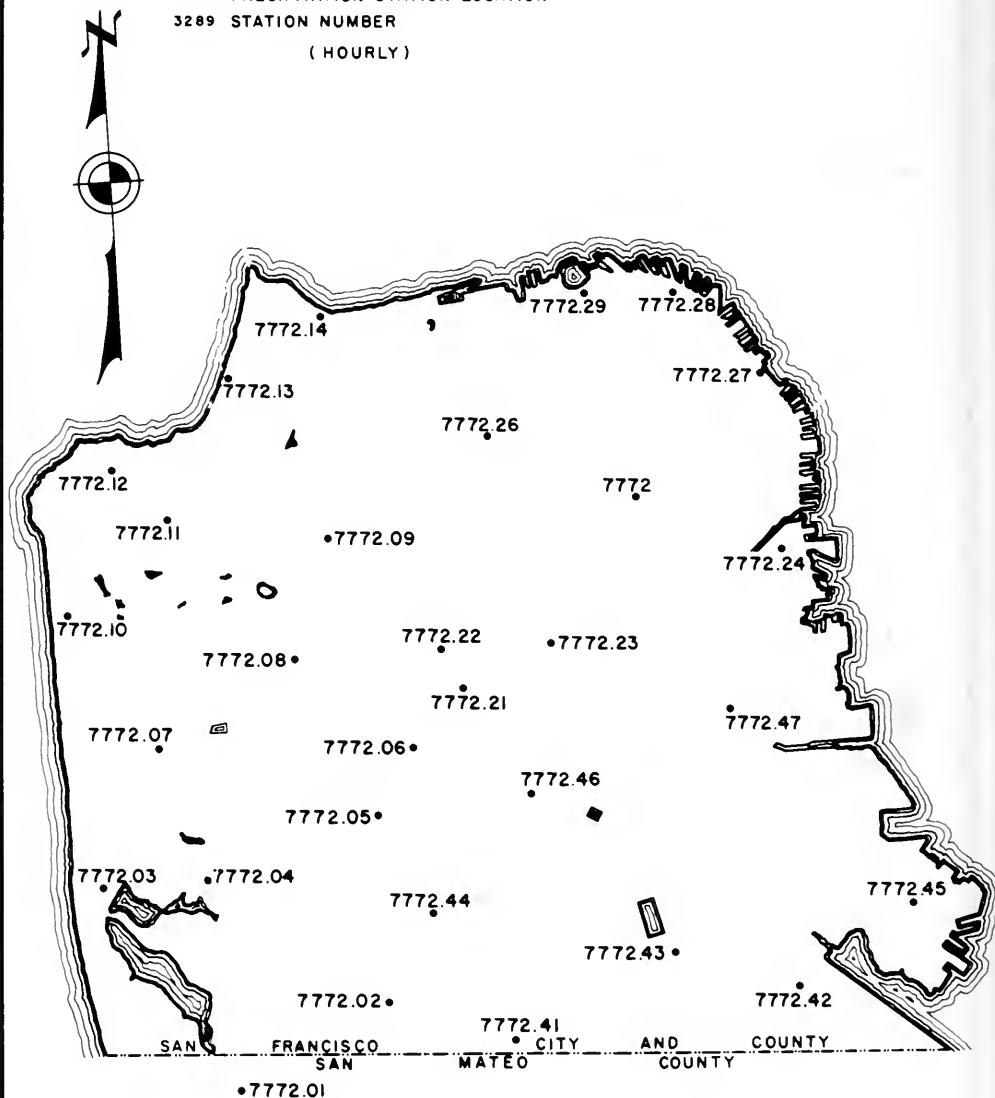


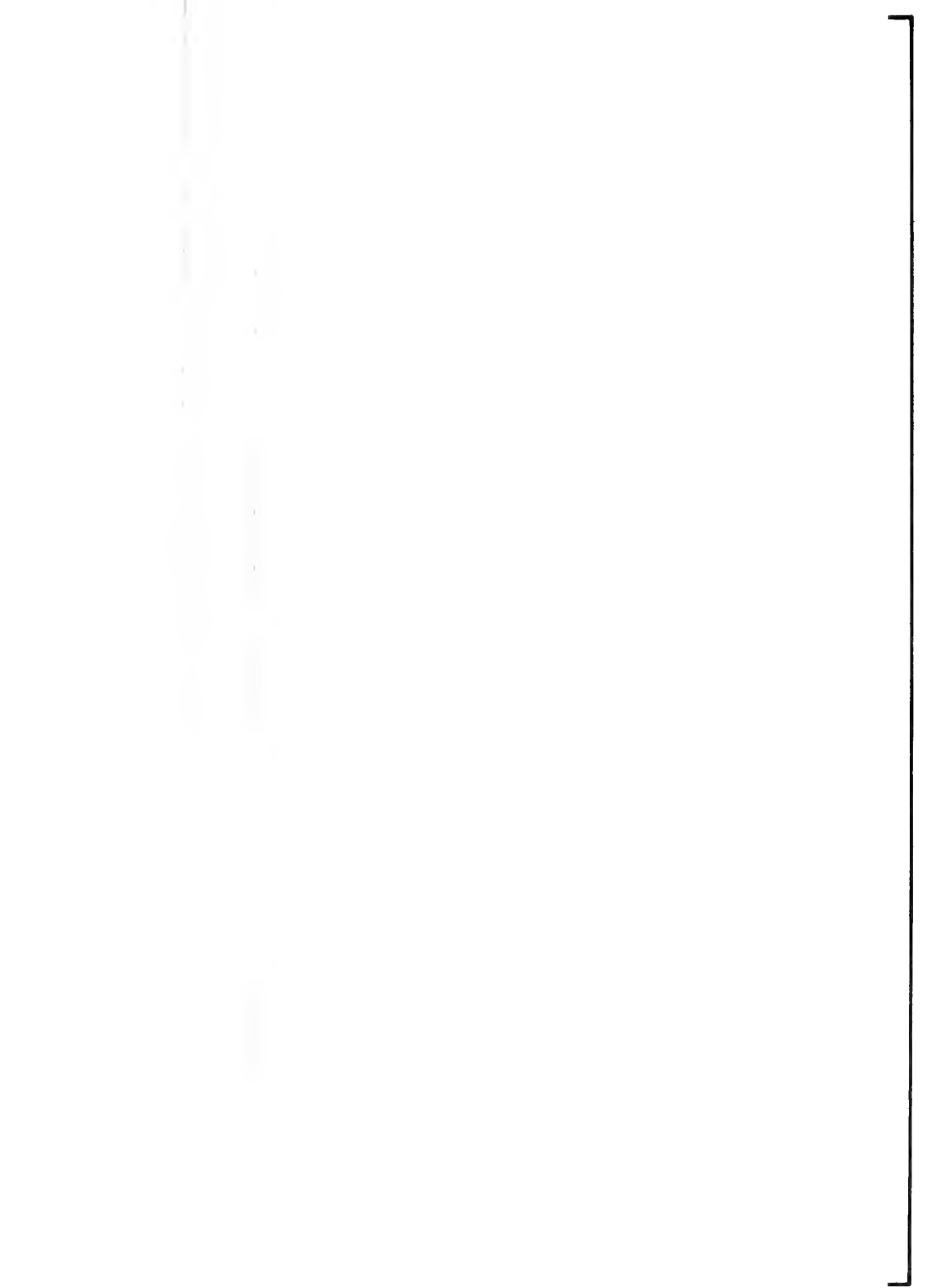
Plate 2 Sheet 5 of 5
Location of
RECORDING RAIN GAGES

June 1976

— LEGEND —

- PRECIPITATION STATION LOCATION
- 3289 STATION NUMBER
- (HOURLY)





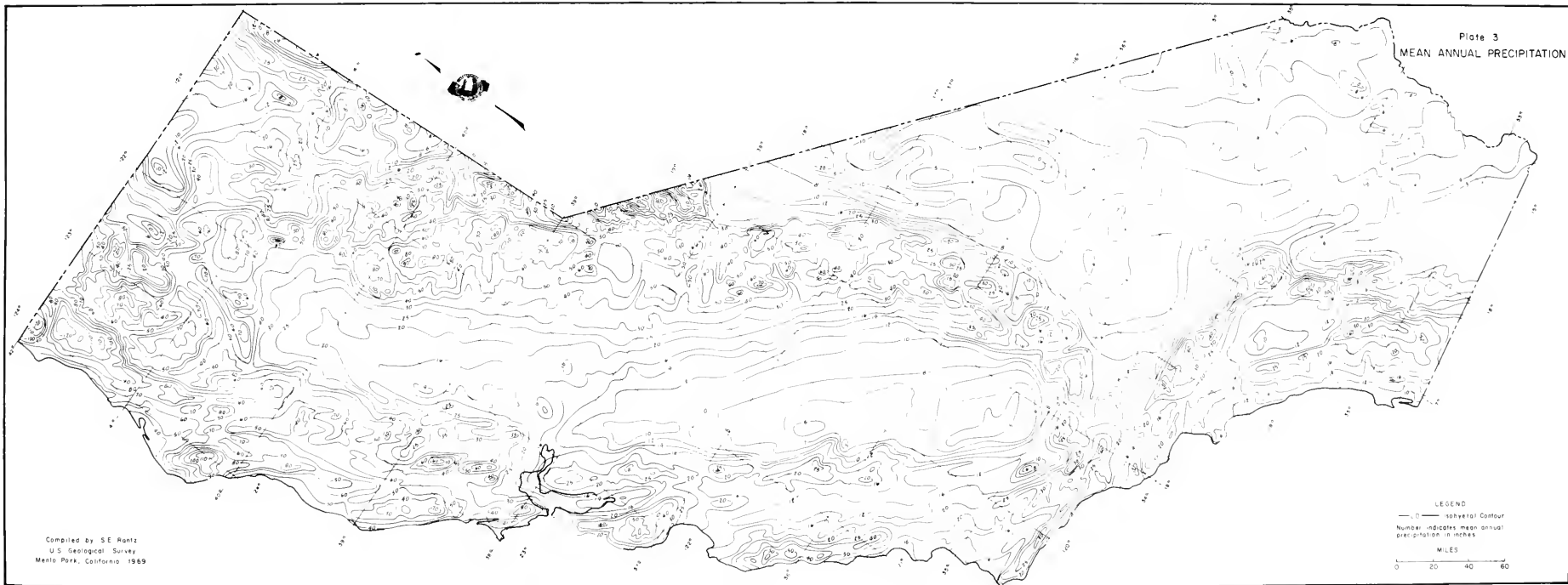




Plate 4
MEAN ONE-HOUR STORM

Units = fraction of the
Mean Annual Precipitation

MILES
0 25 50 75 100

KILOMETRES
0 50 100 150

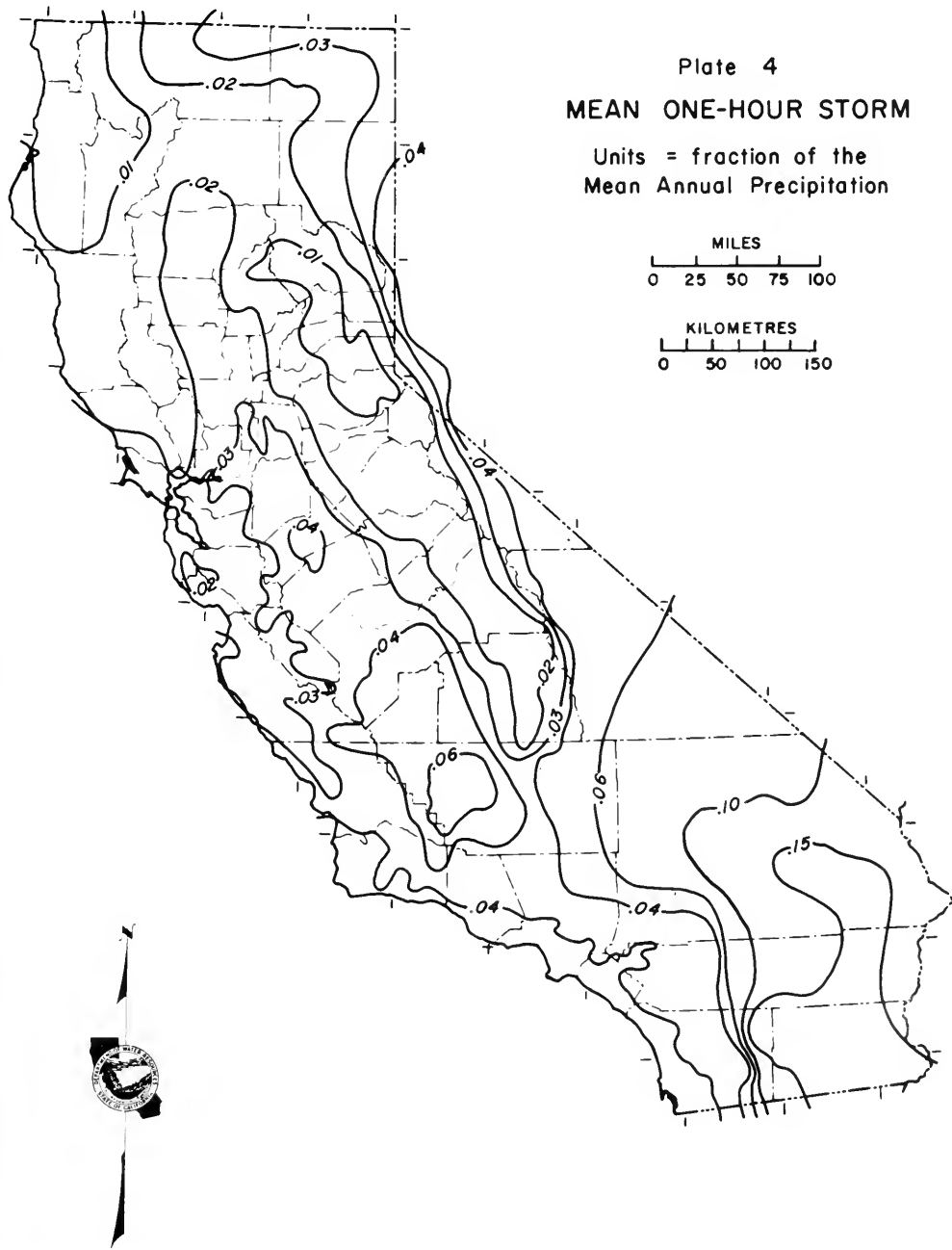
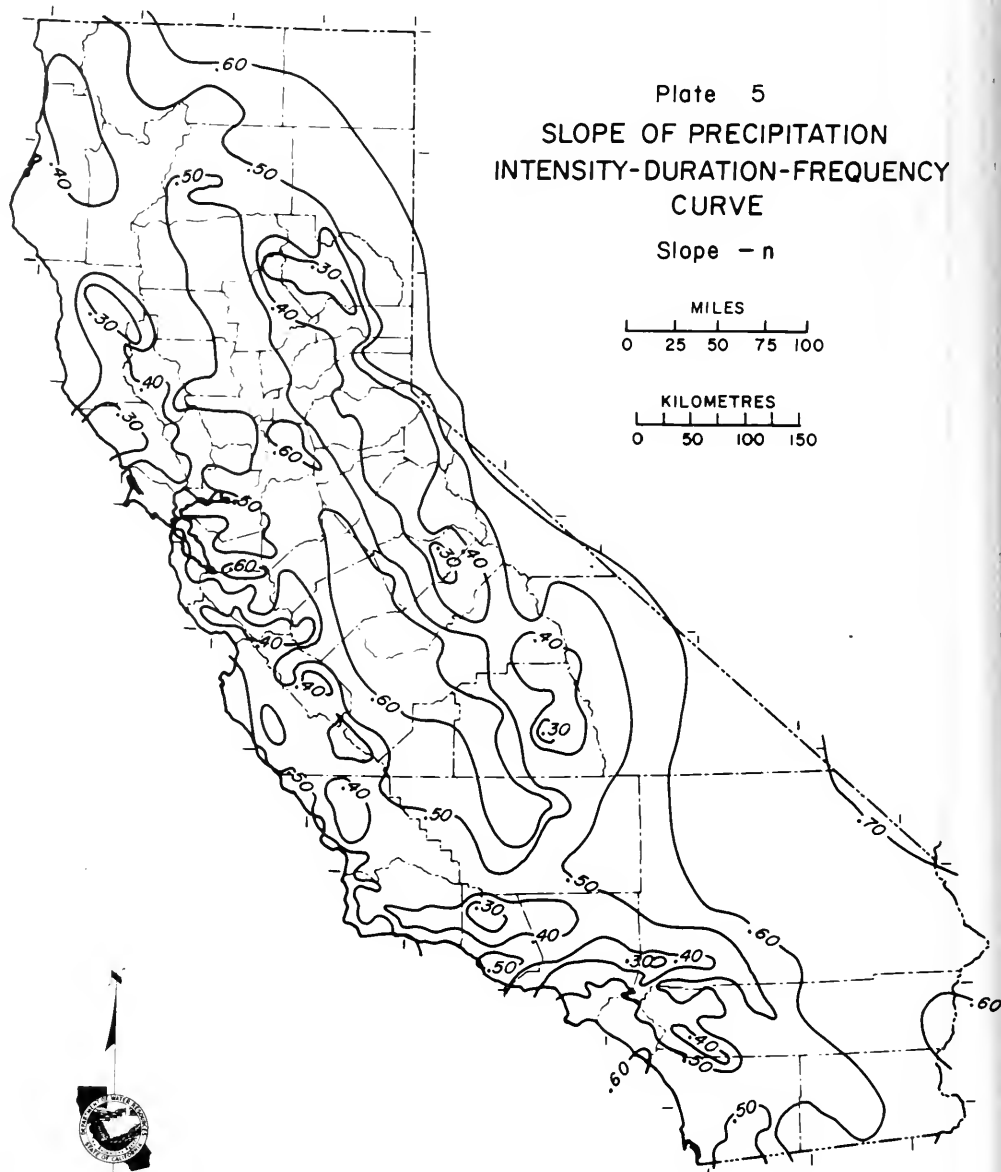


Plate 5
SLOPE OF PRECIPITATION
INTENSITY-DURATION-FREQUENCY
CURVE

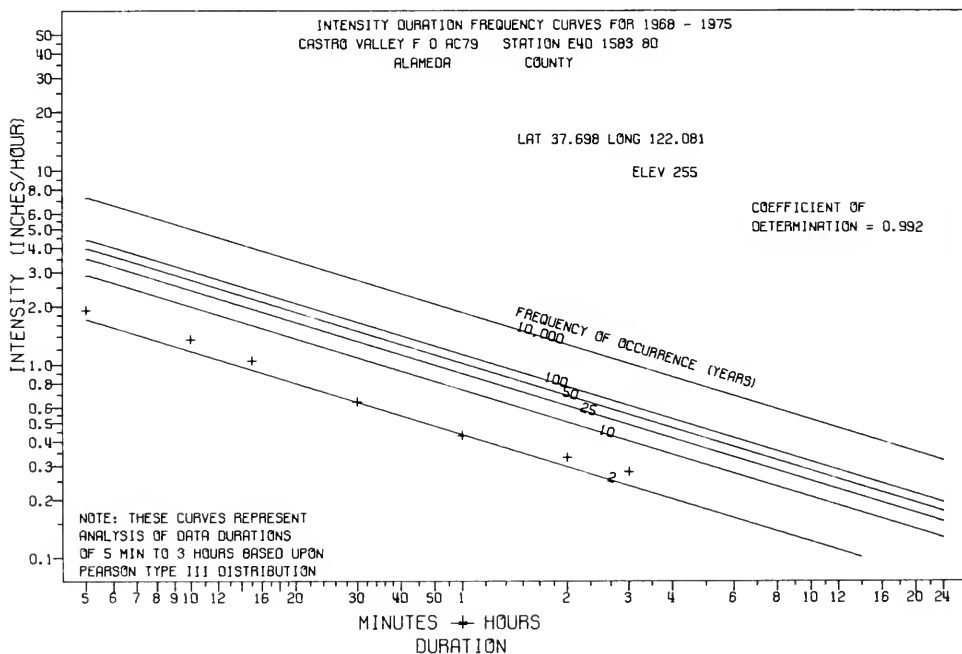
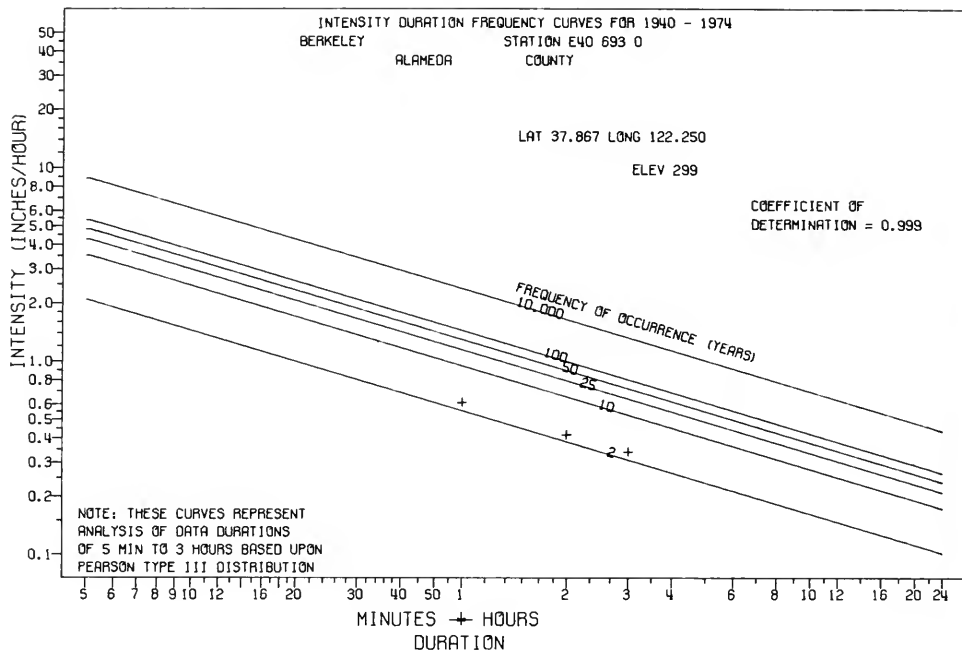
Slope - n

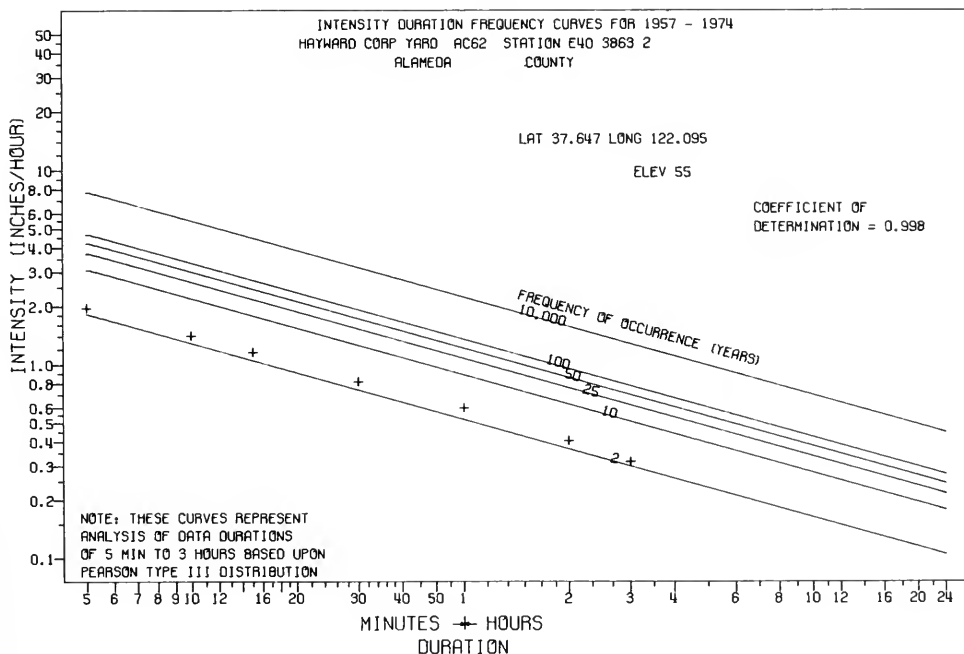
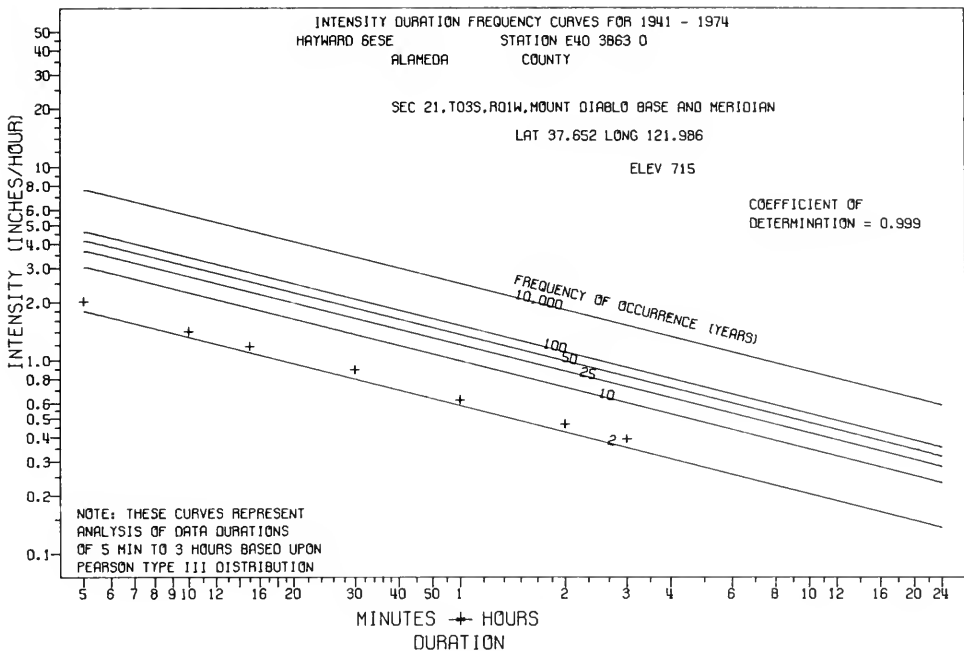
MILES
0 25 50 75 100

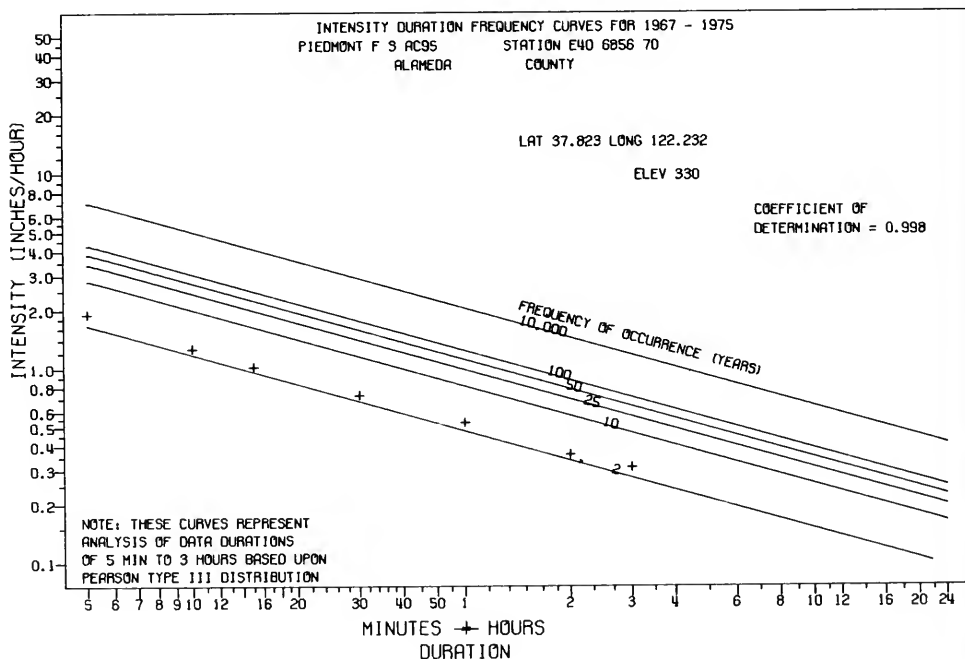
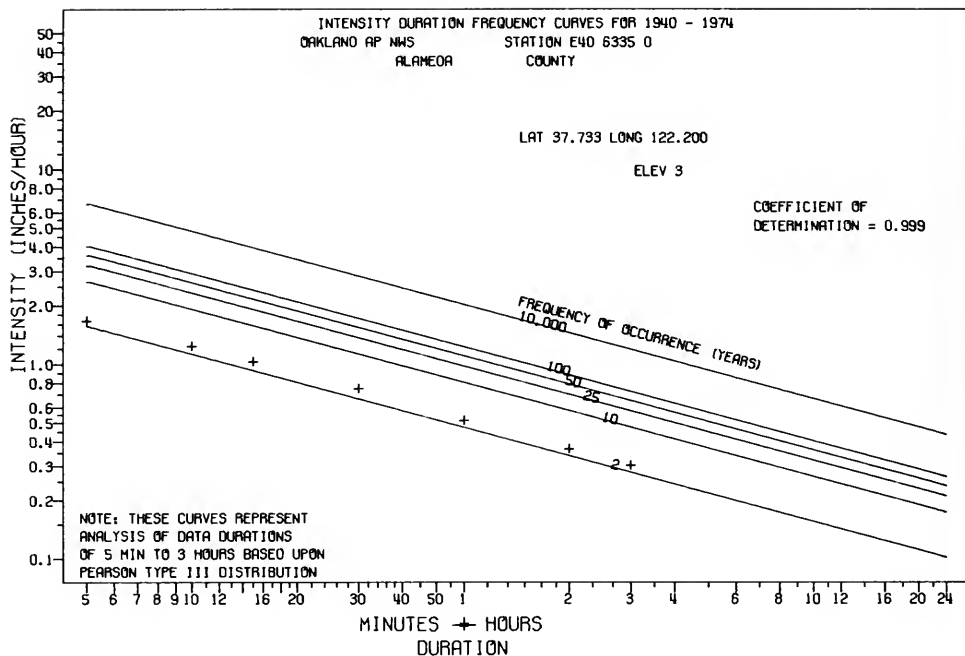
KILOMETRES
0 50 100 150

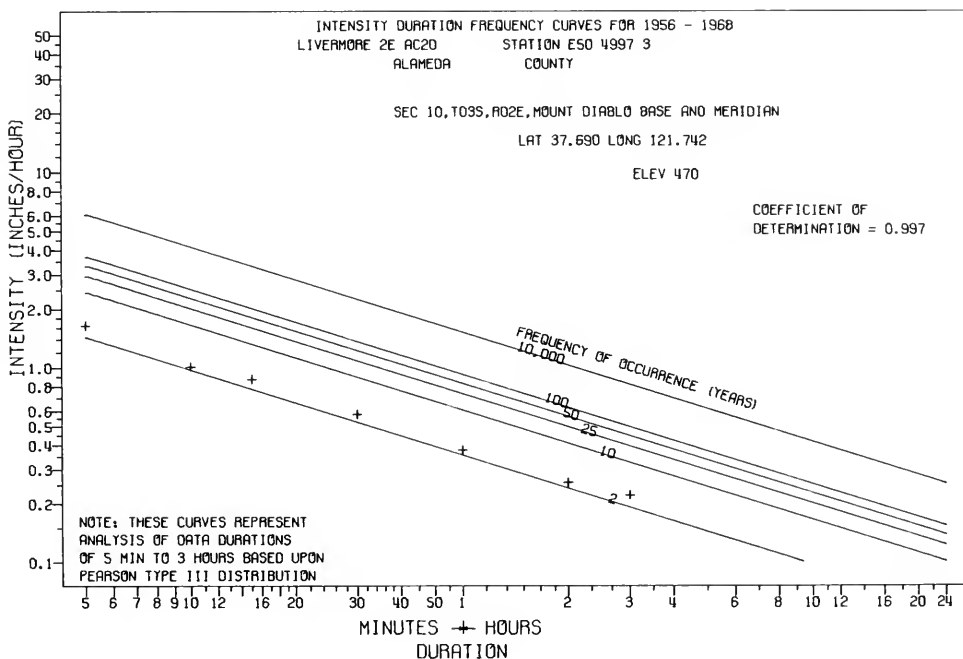
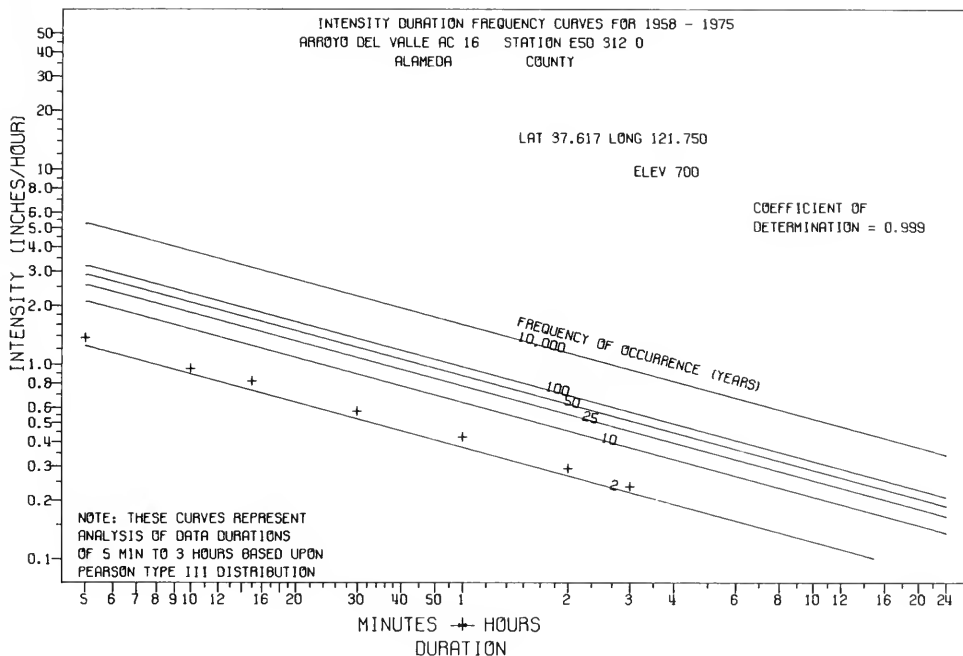


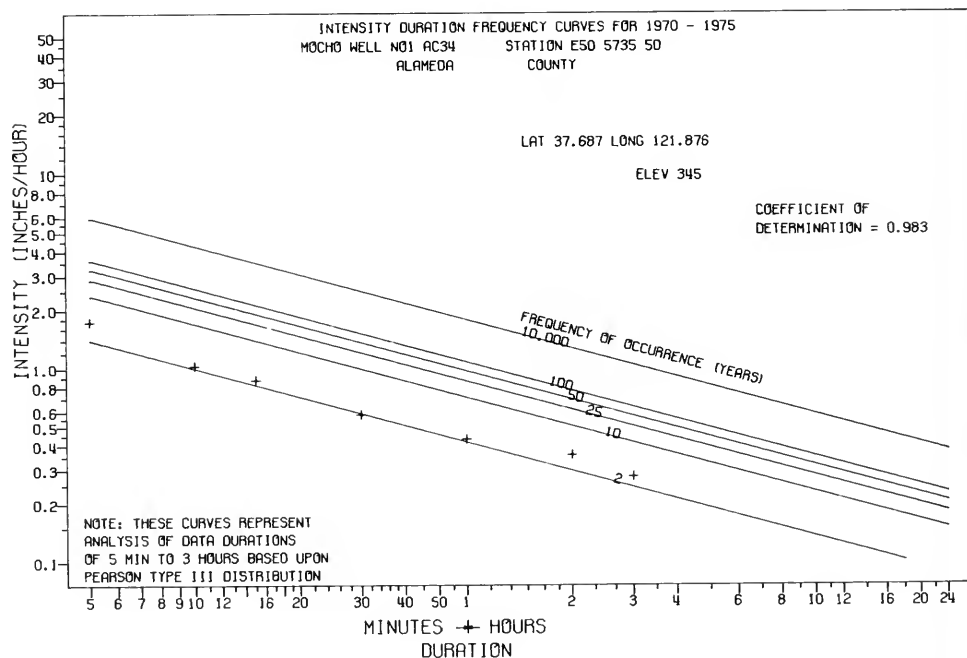
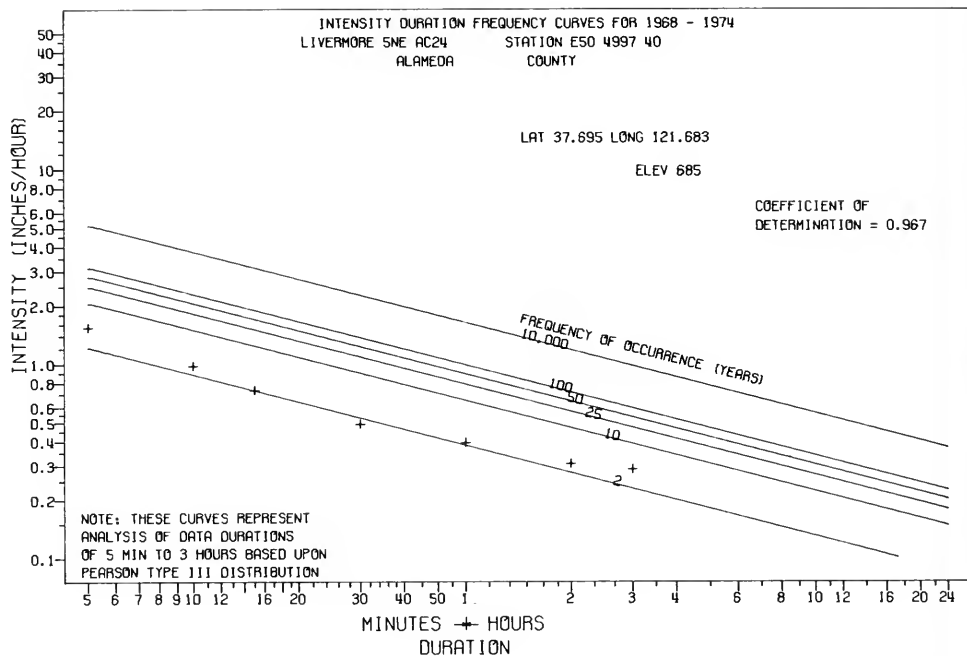
INTENSITY-DURATION-FREQUENCY CURVES

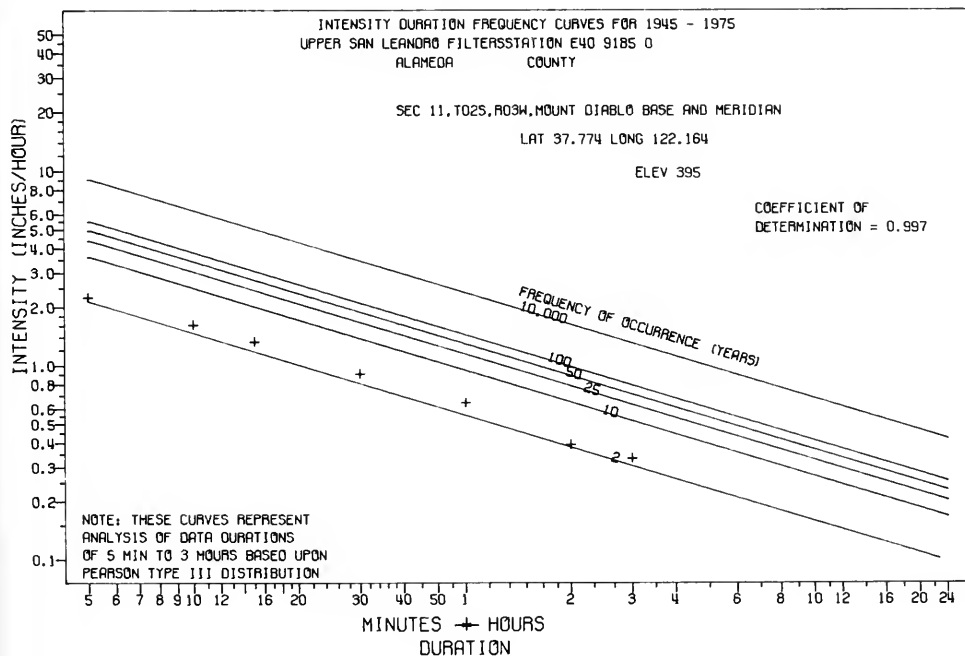
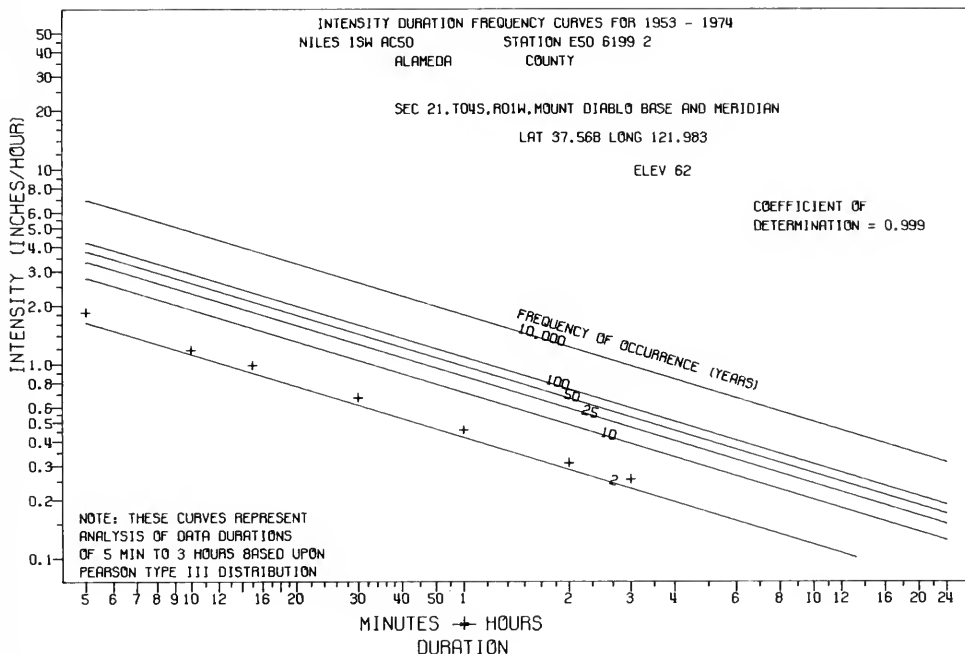


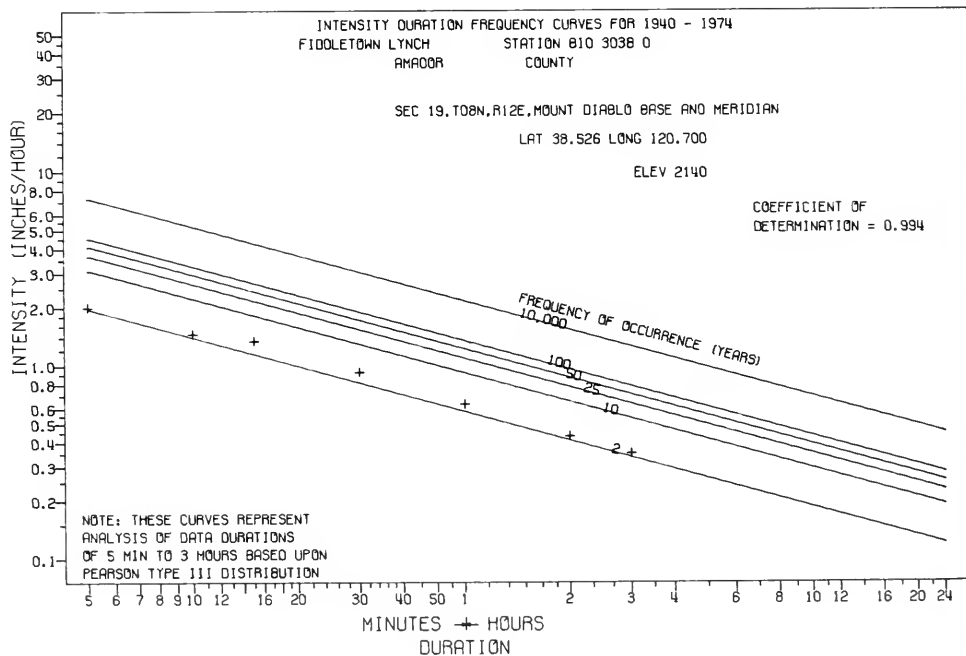
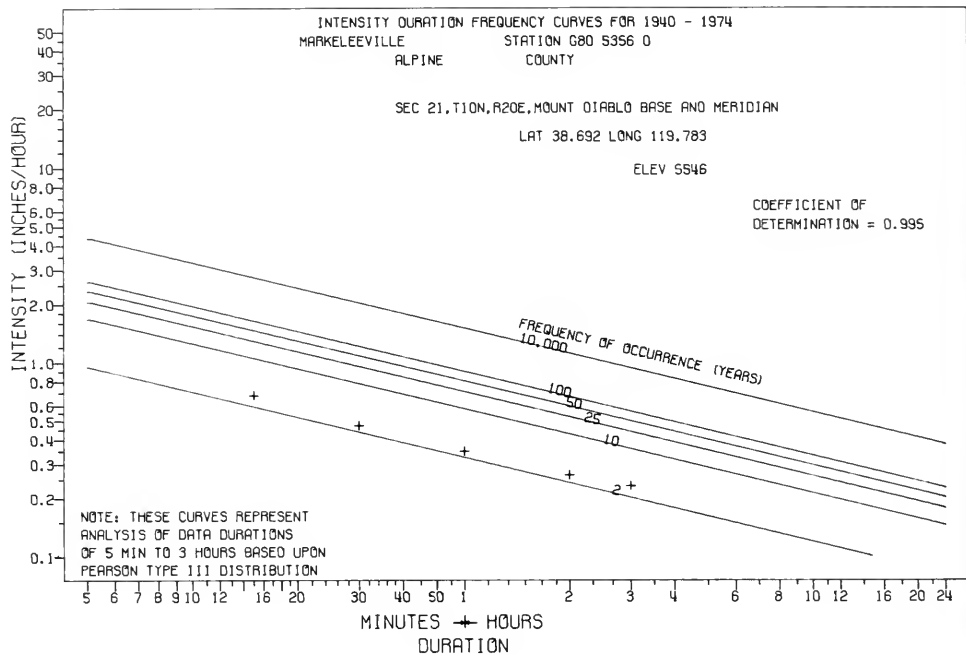


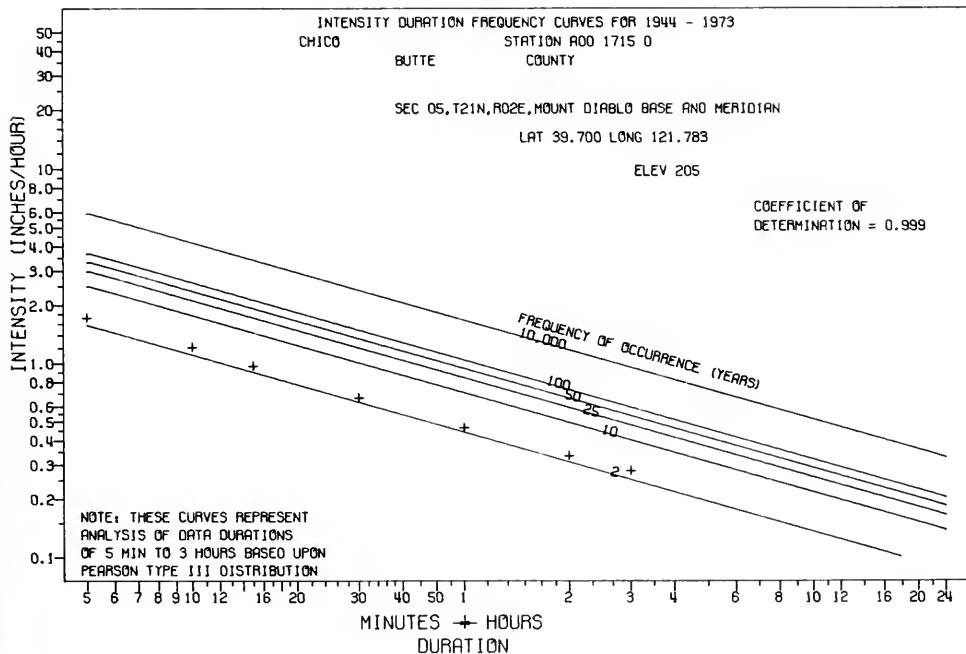
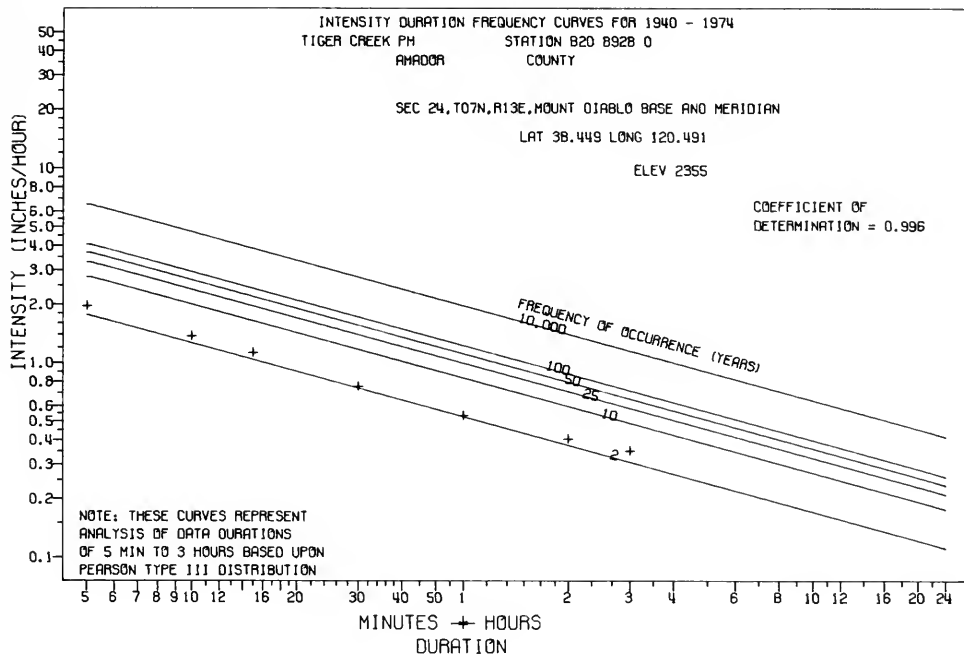


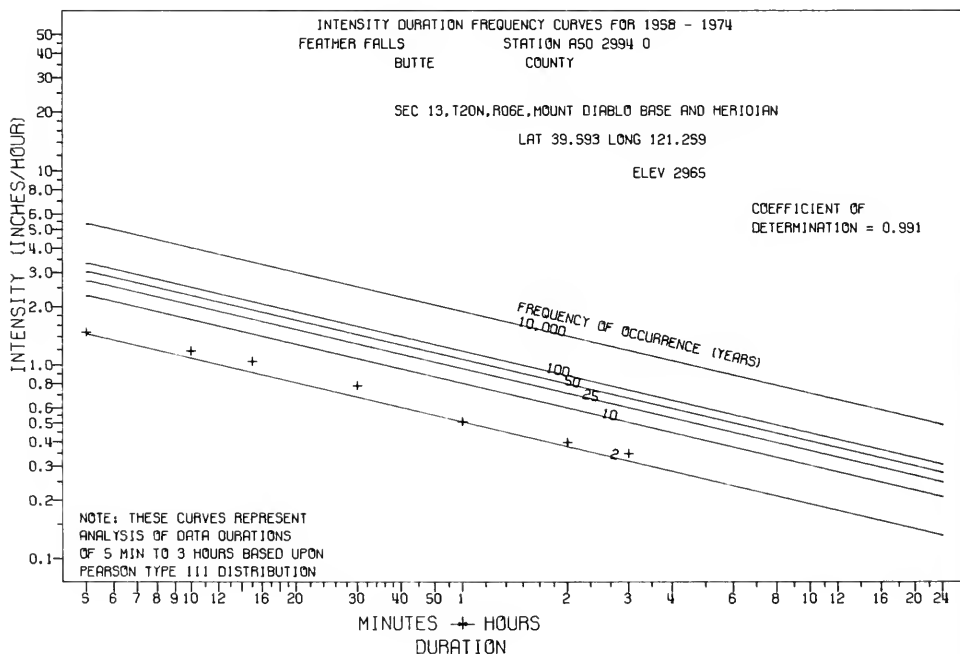
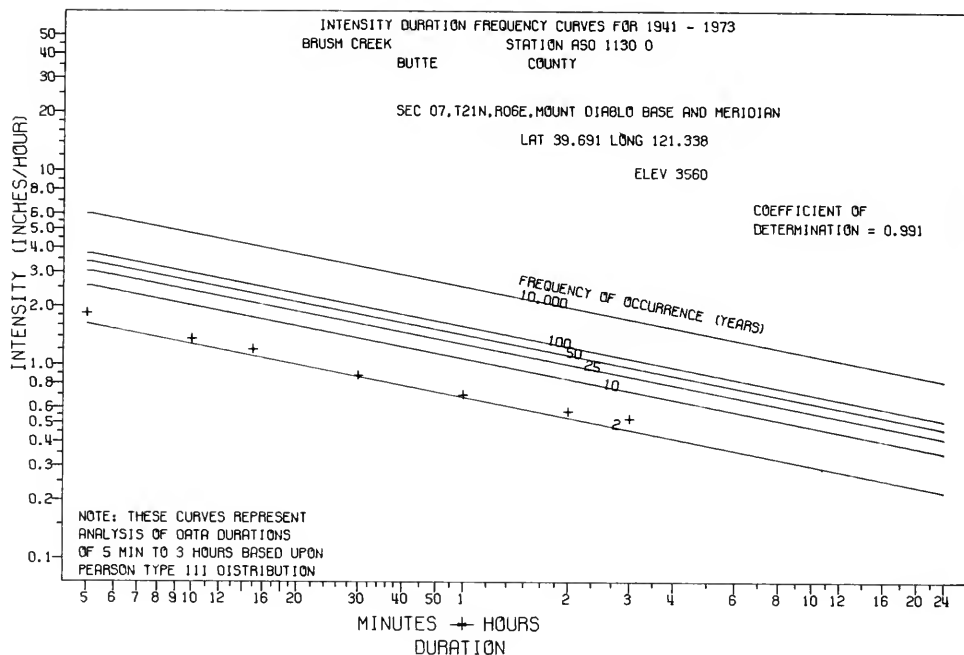


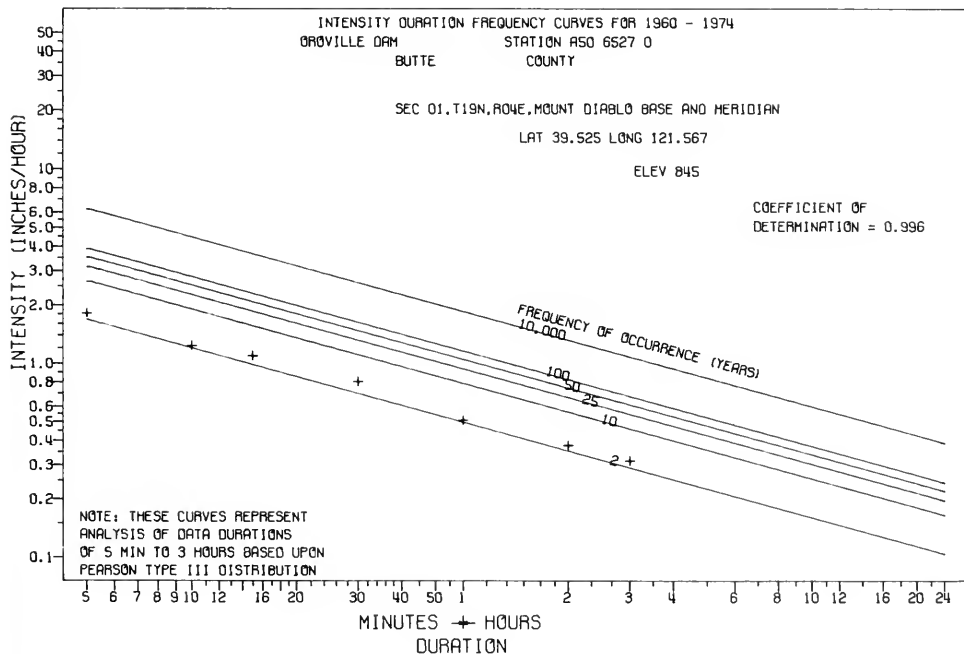
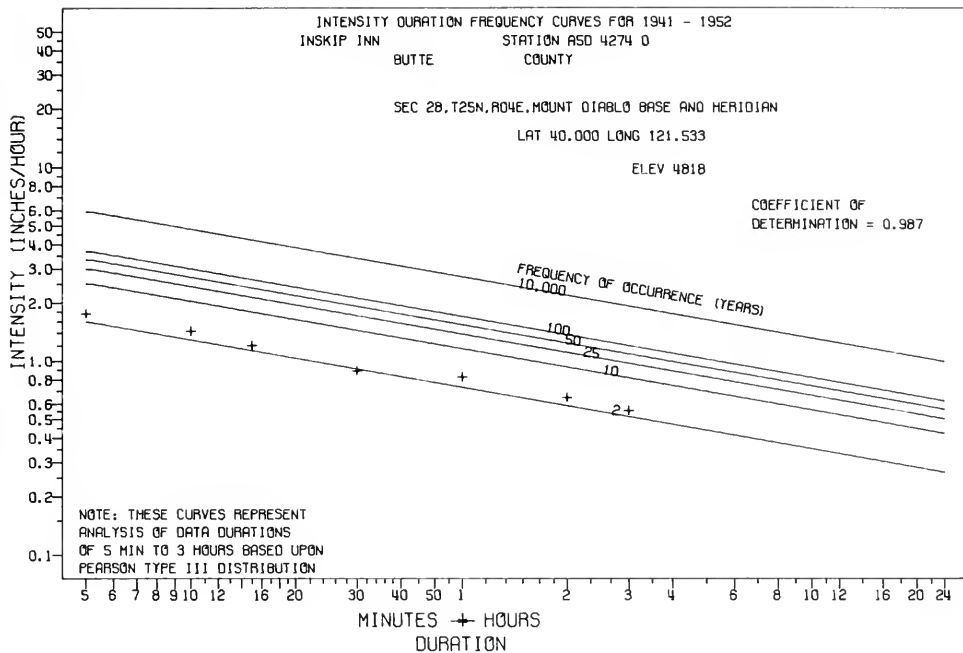


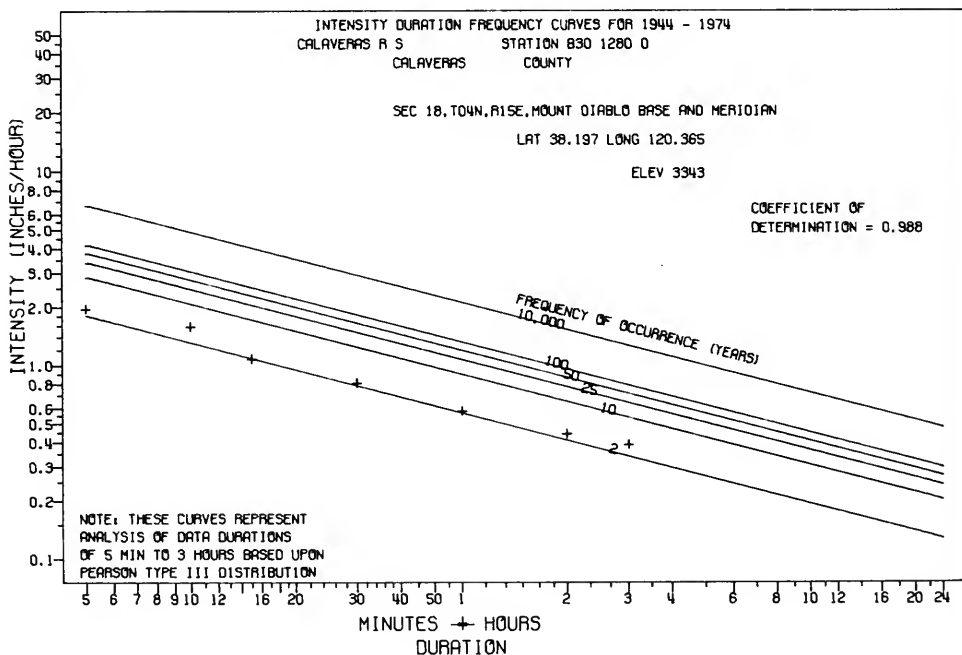
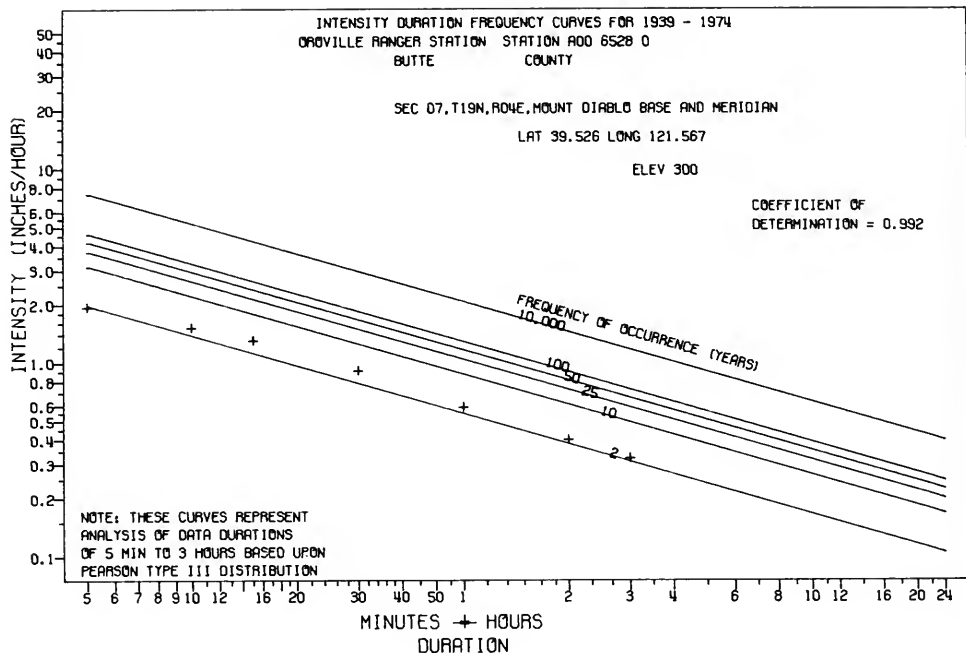


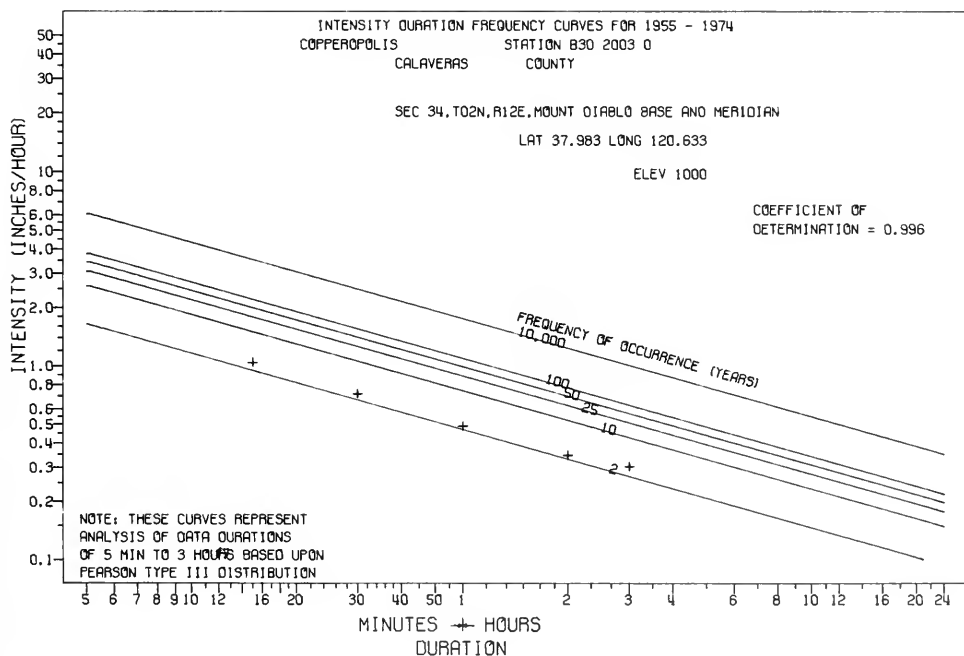
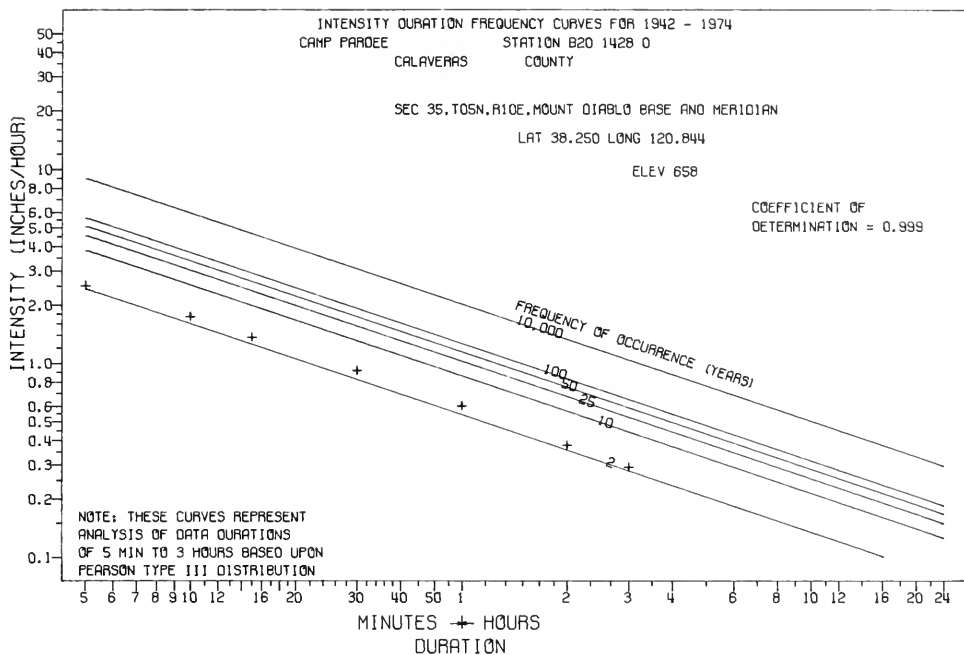


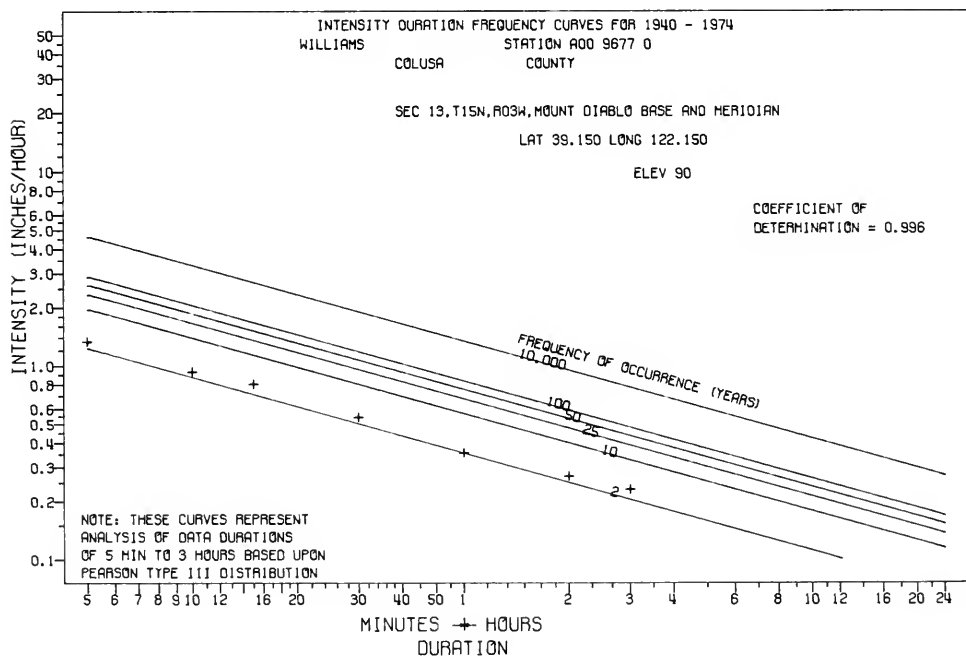
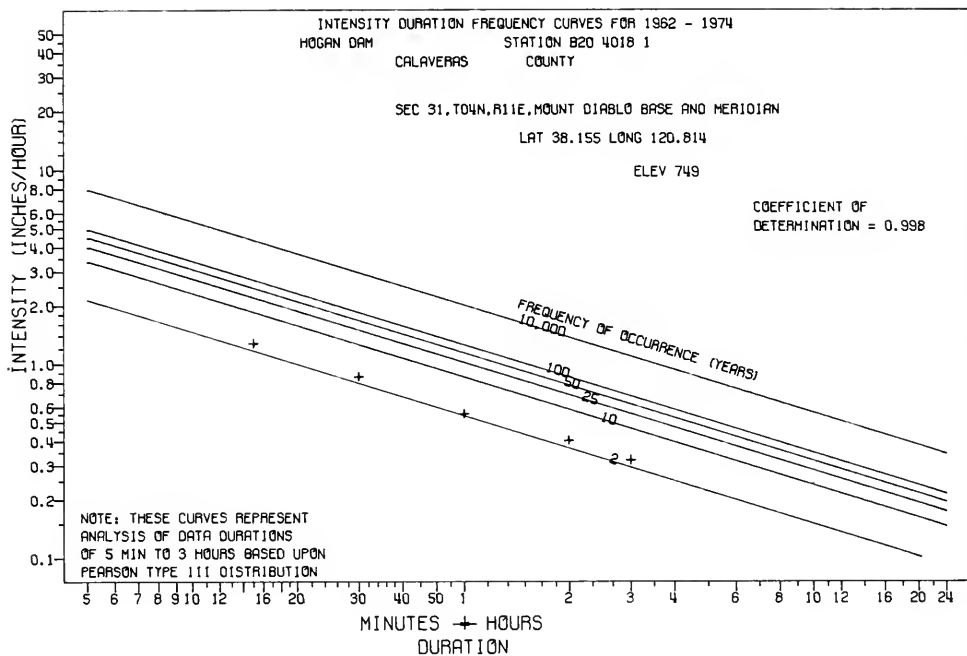


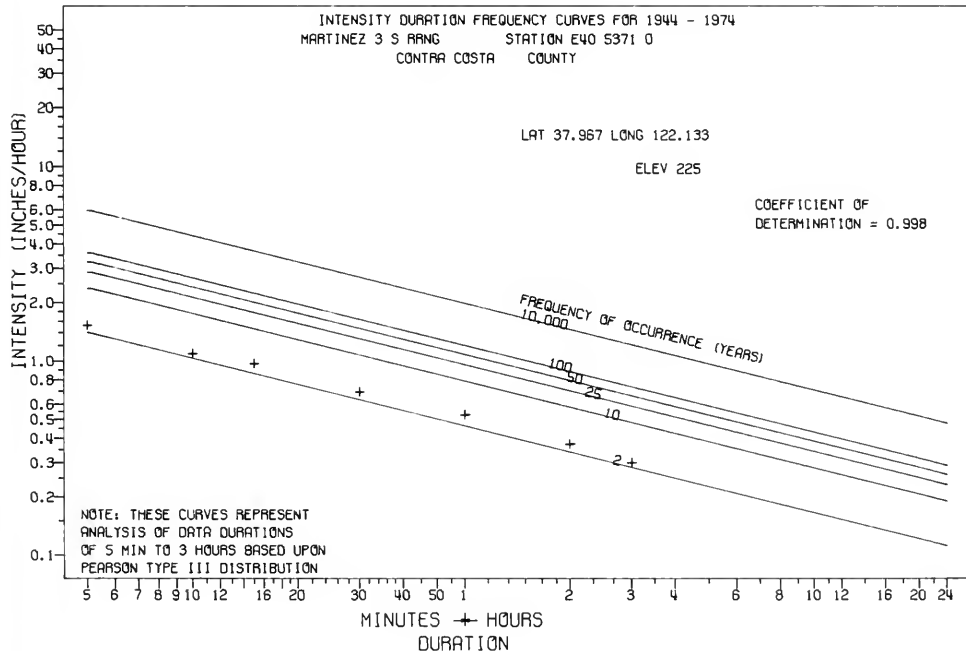
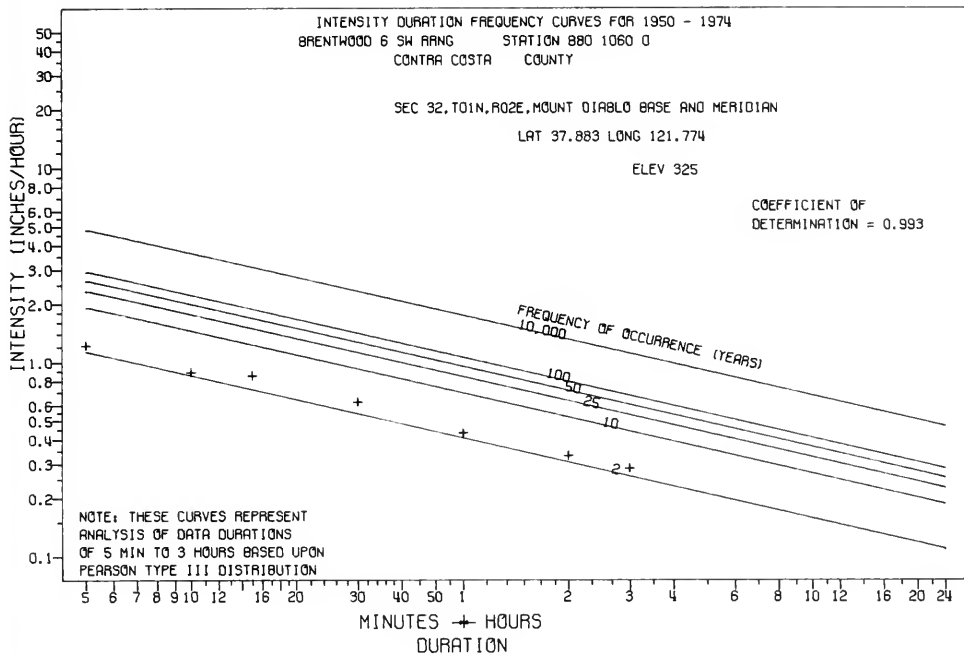


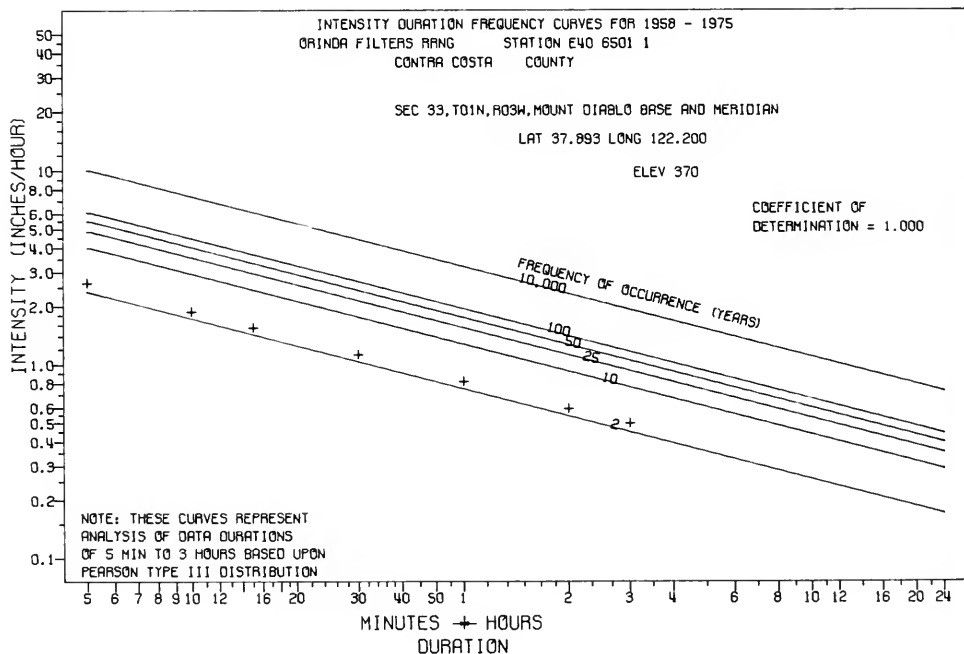
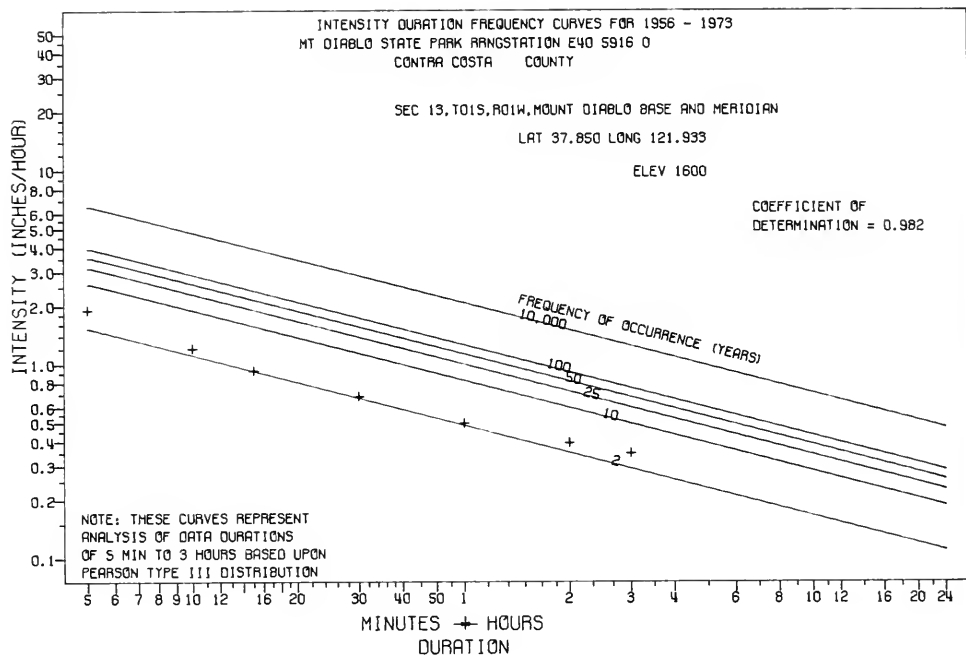


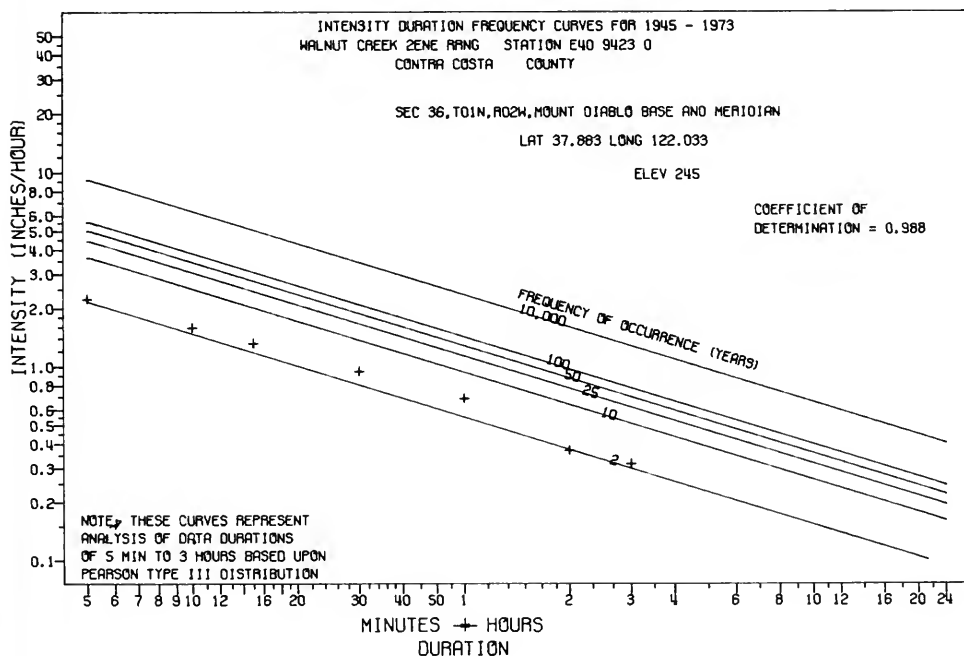
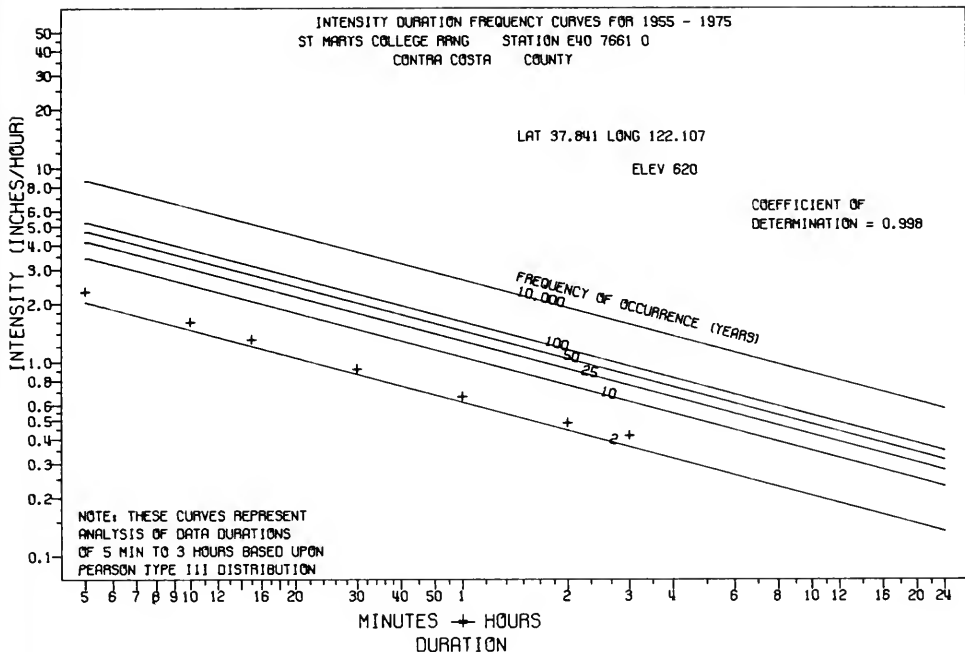


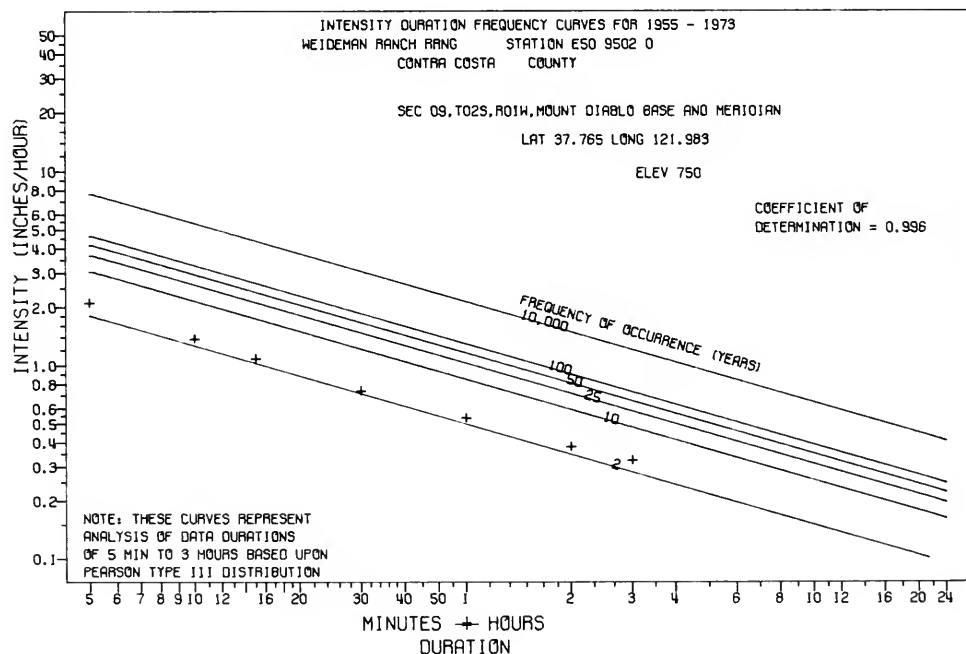
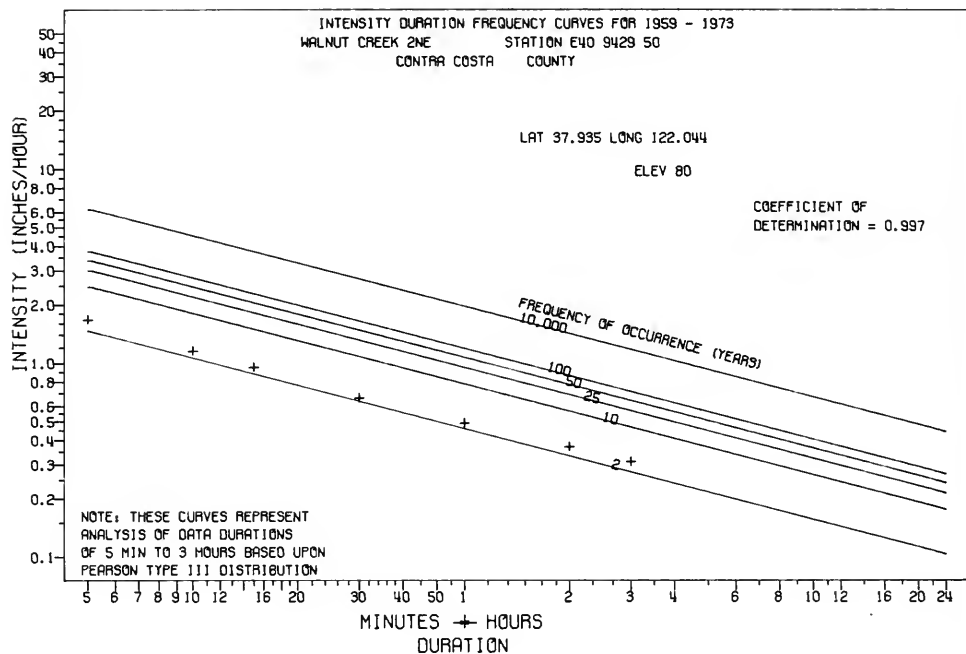


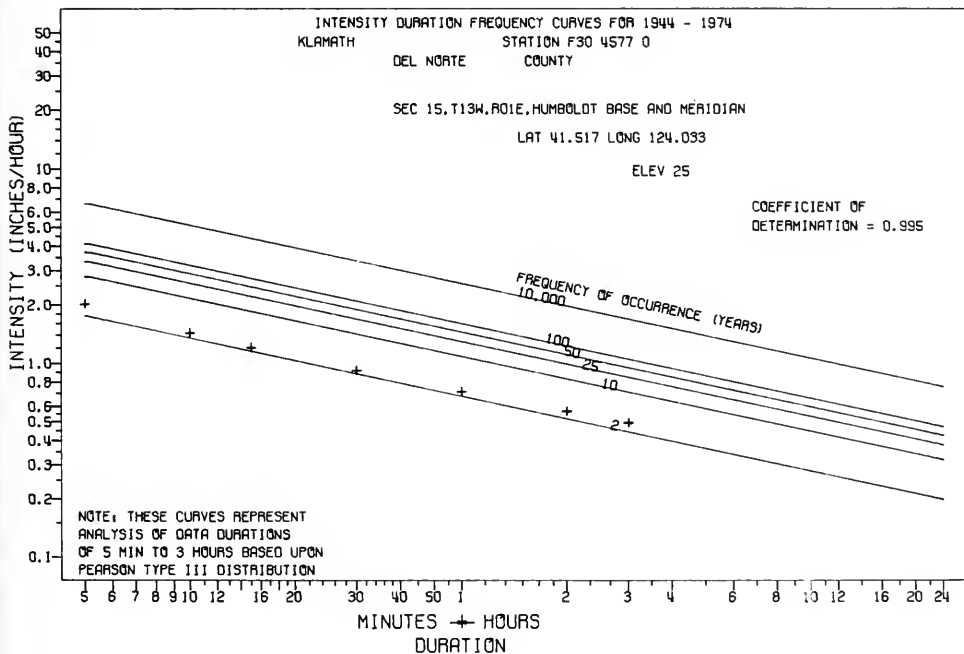
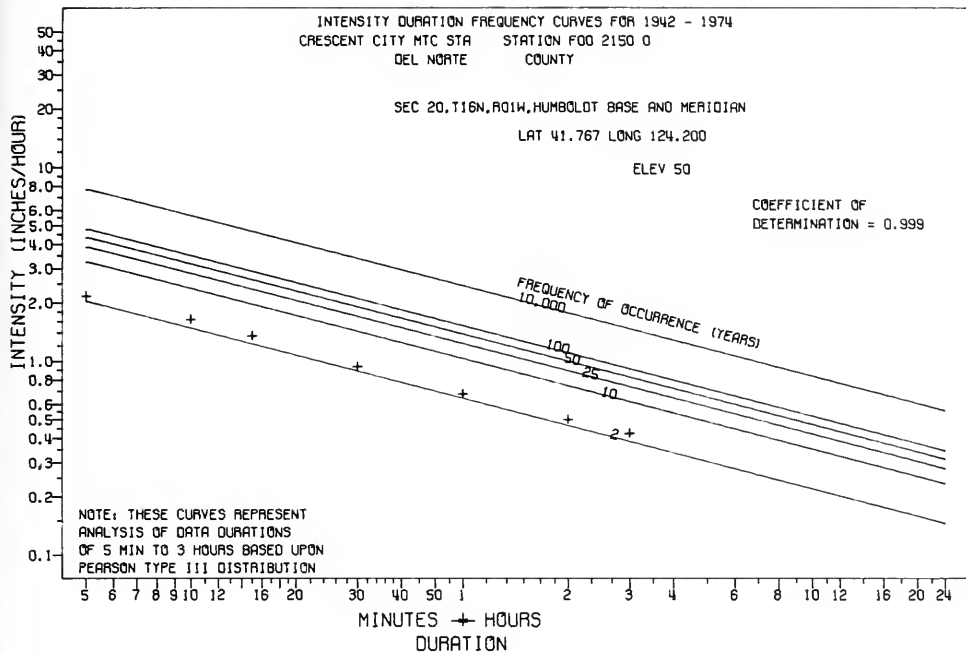


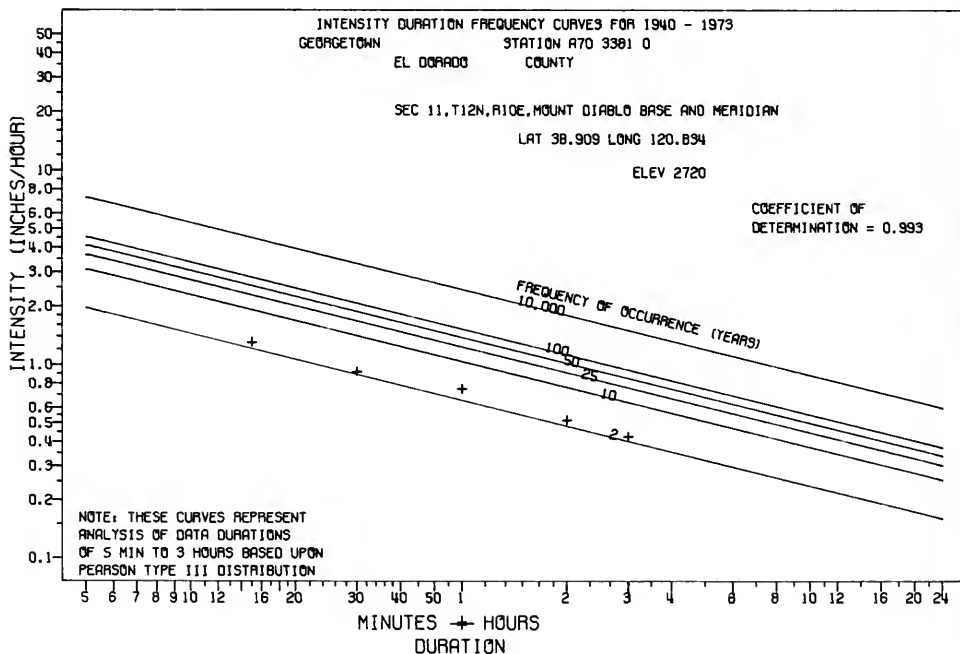
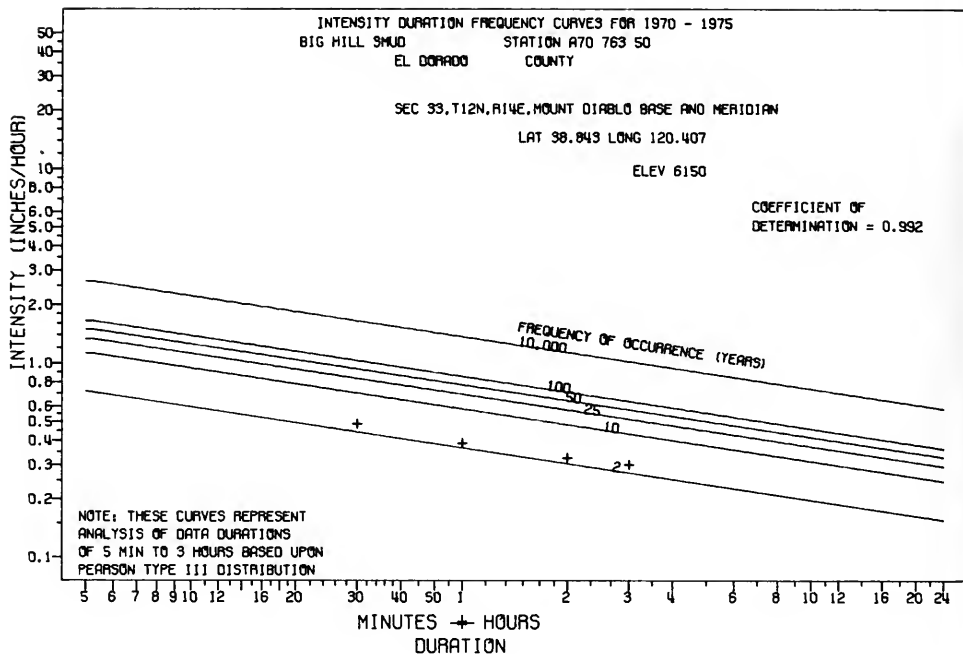


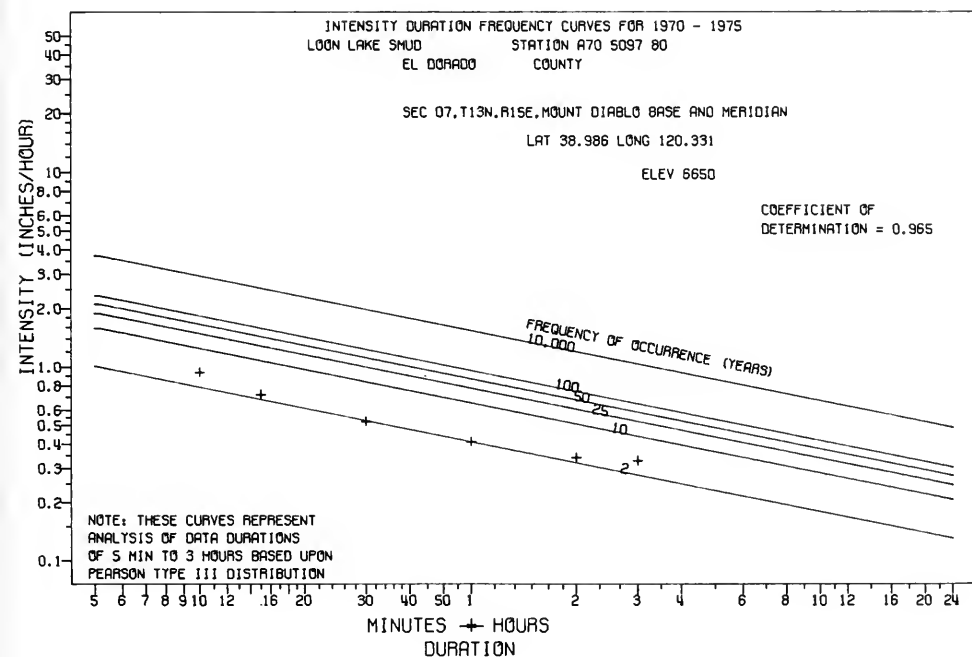
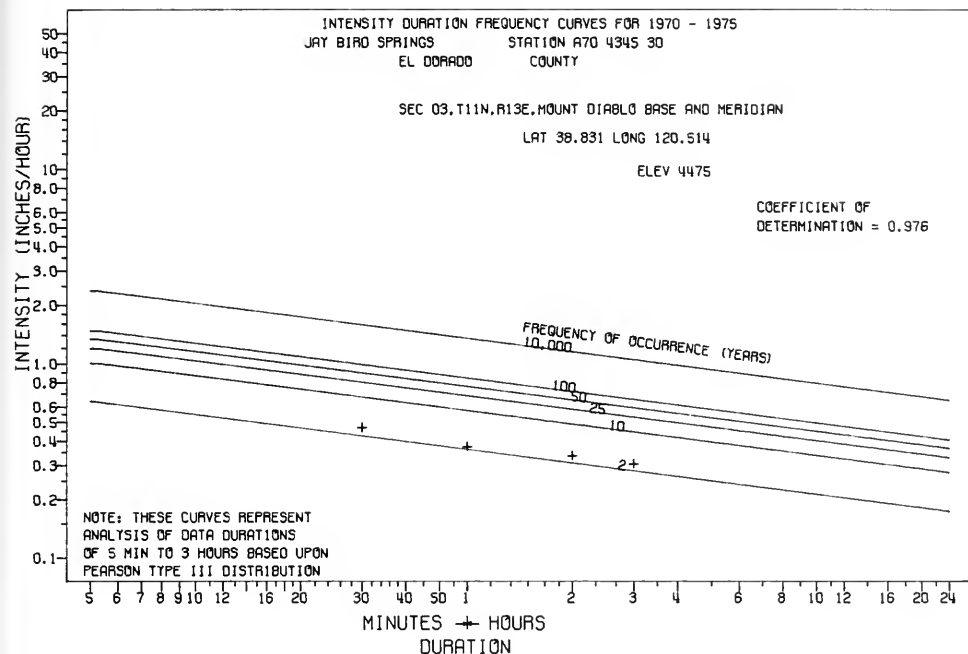


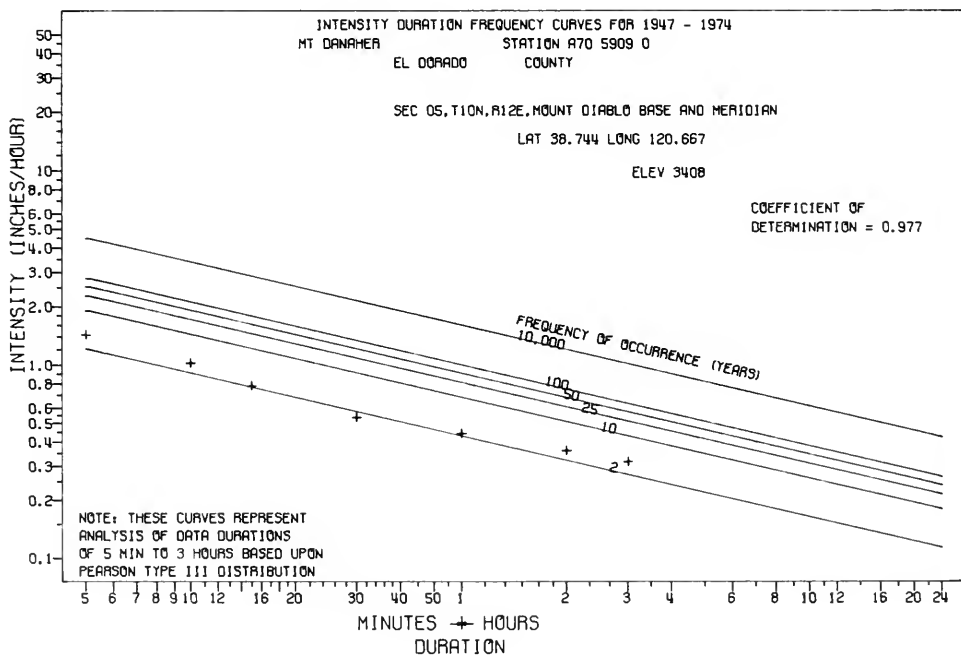
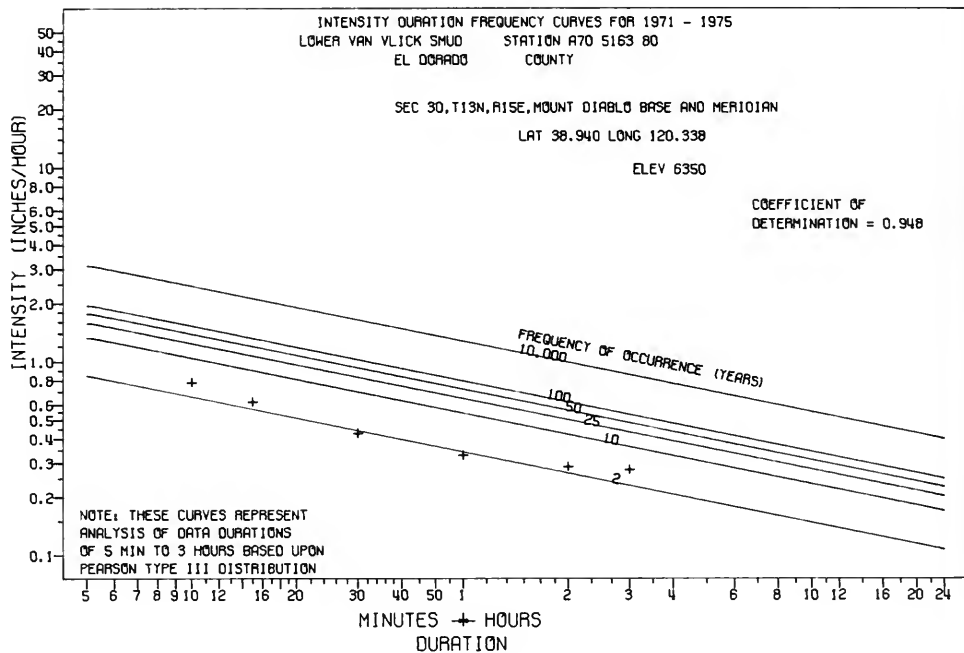


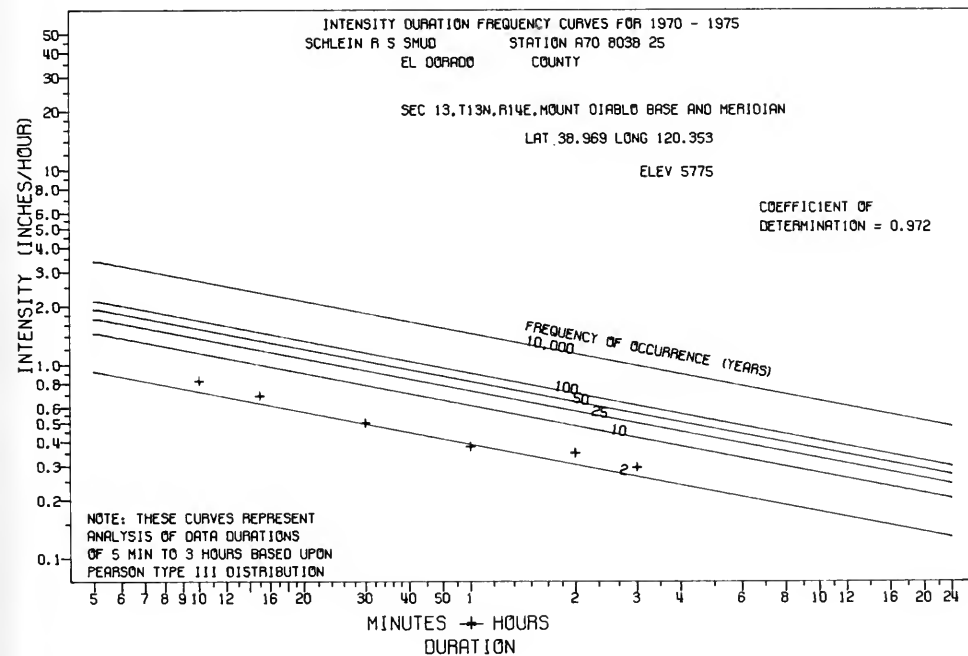
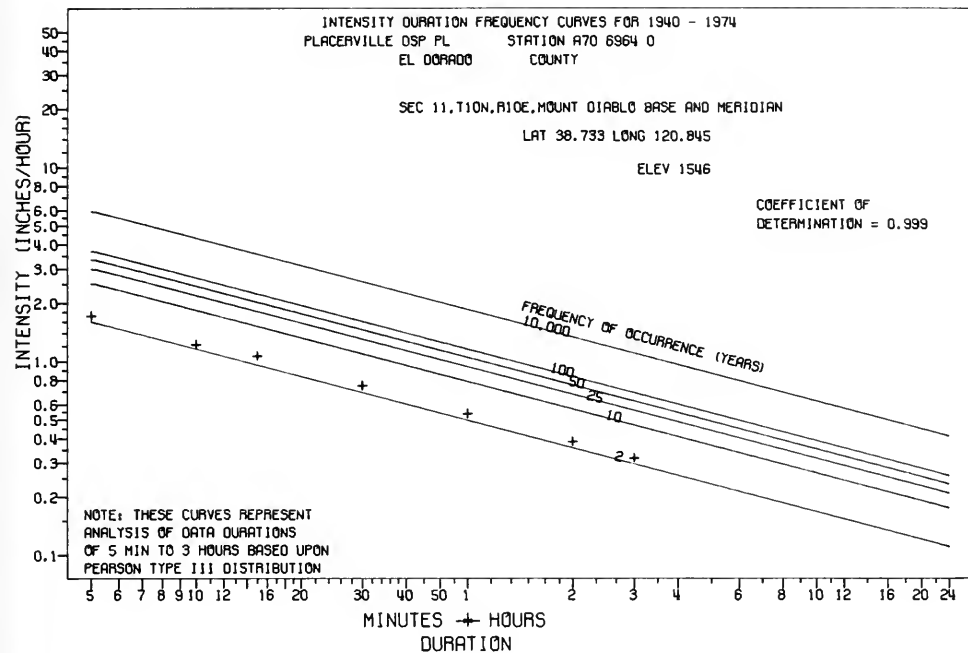


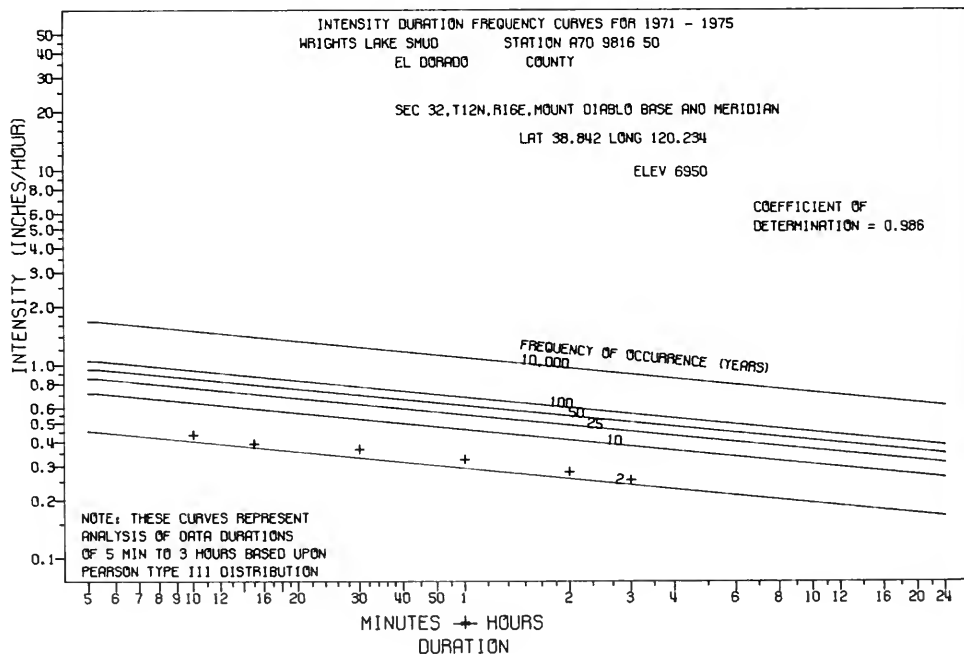
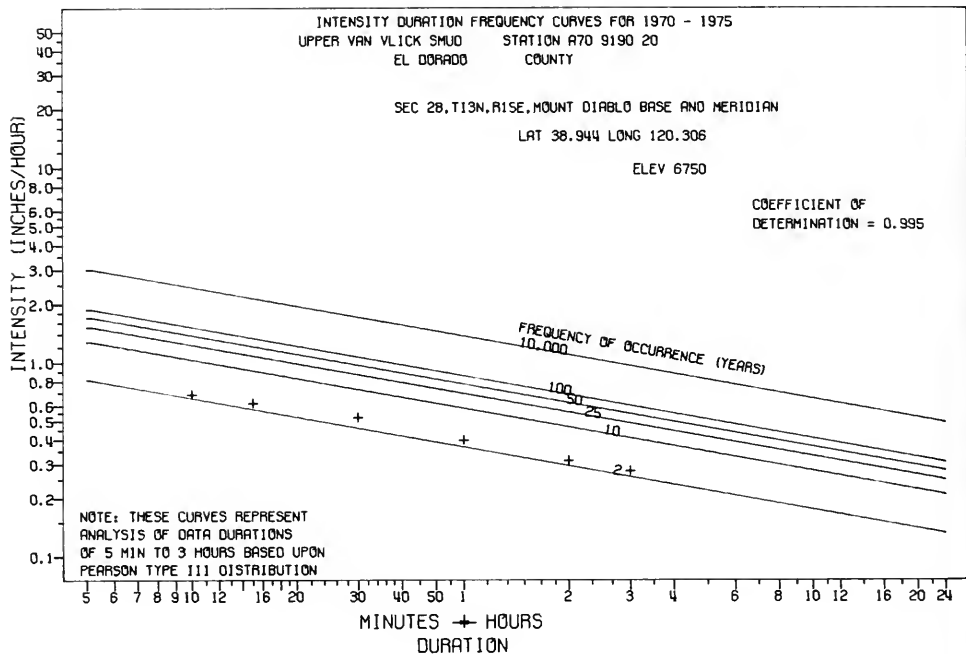


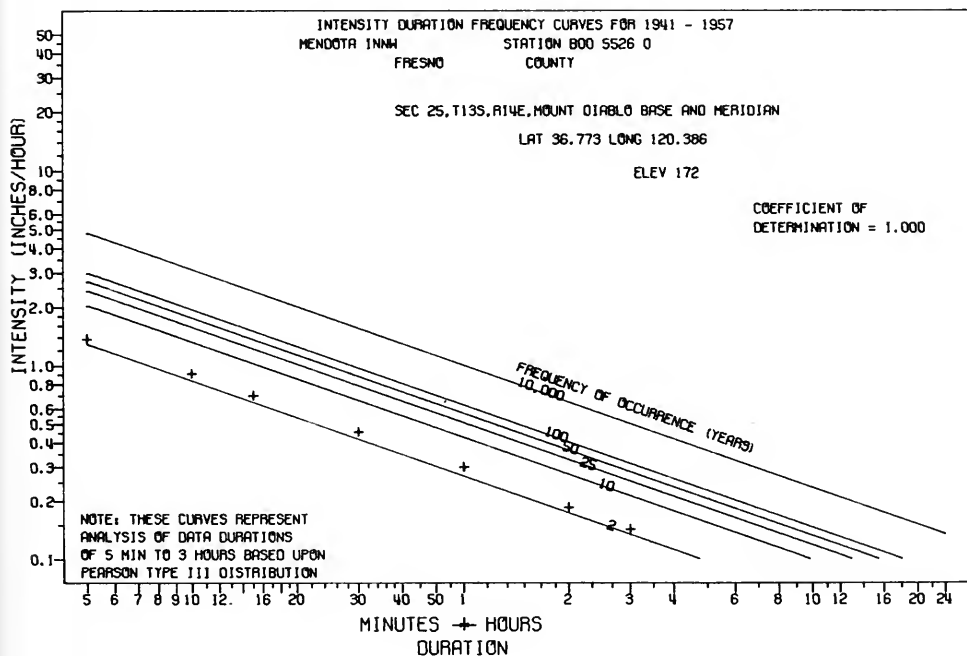
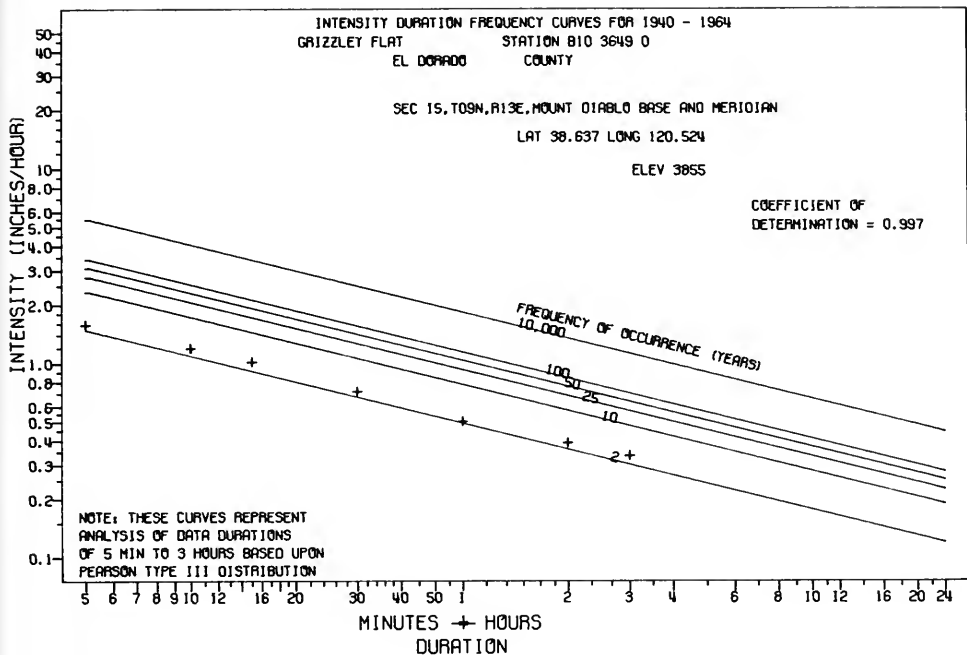


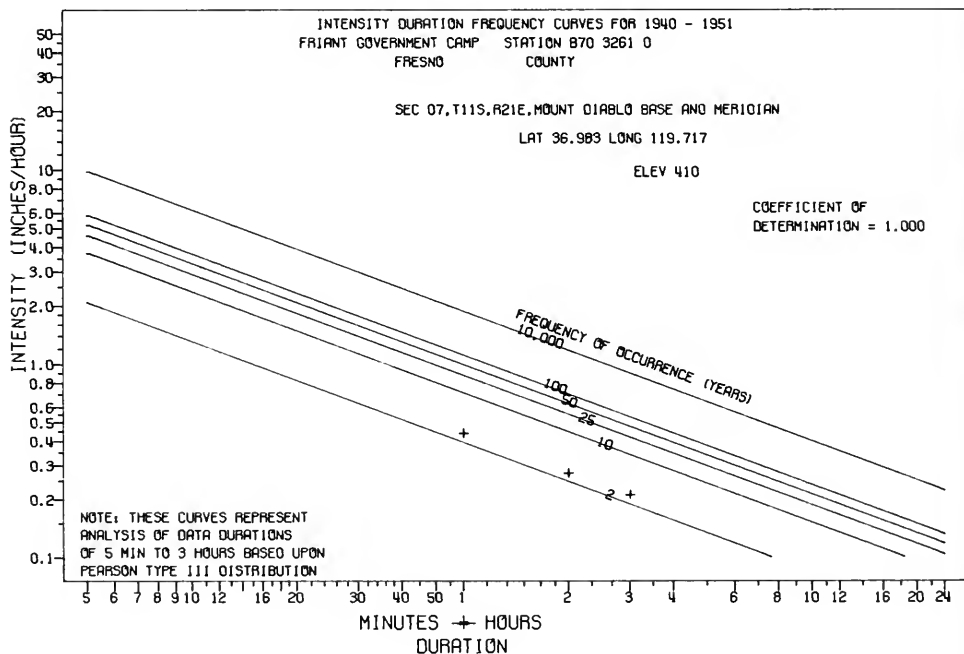
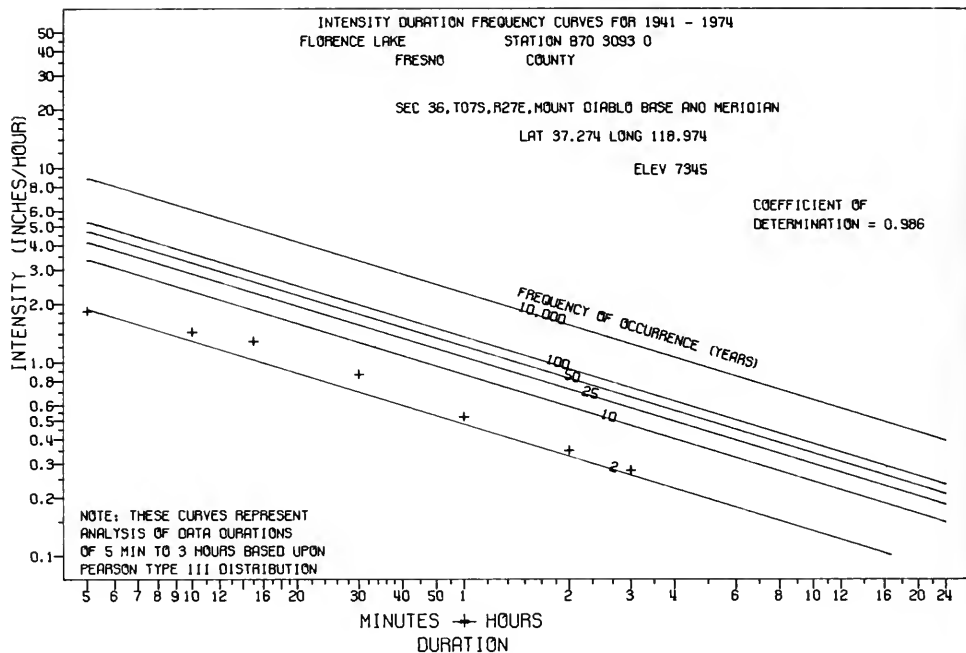


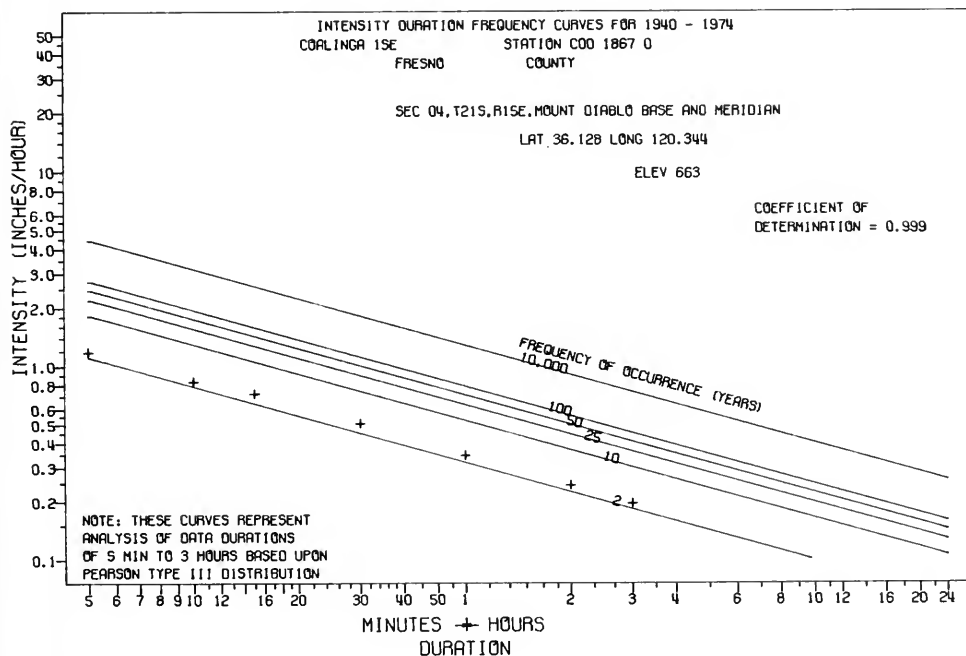
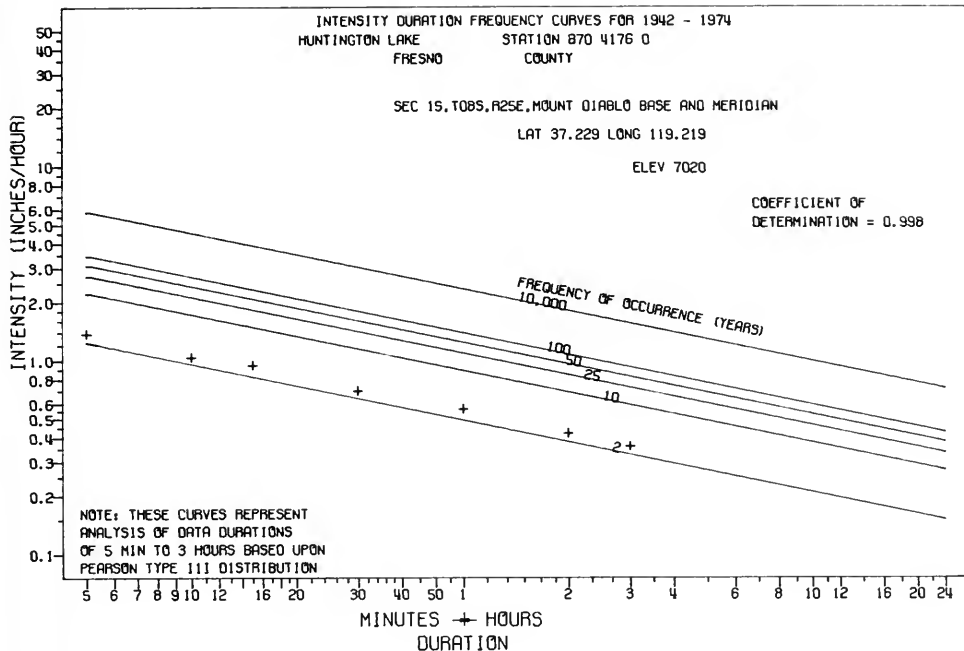


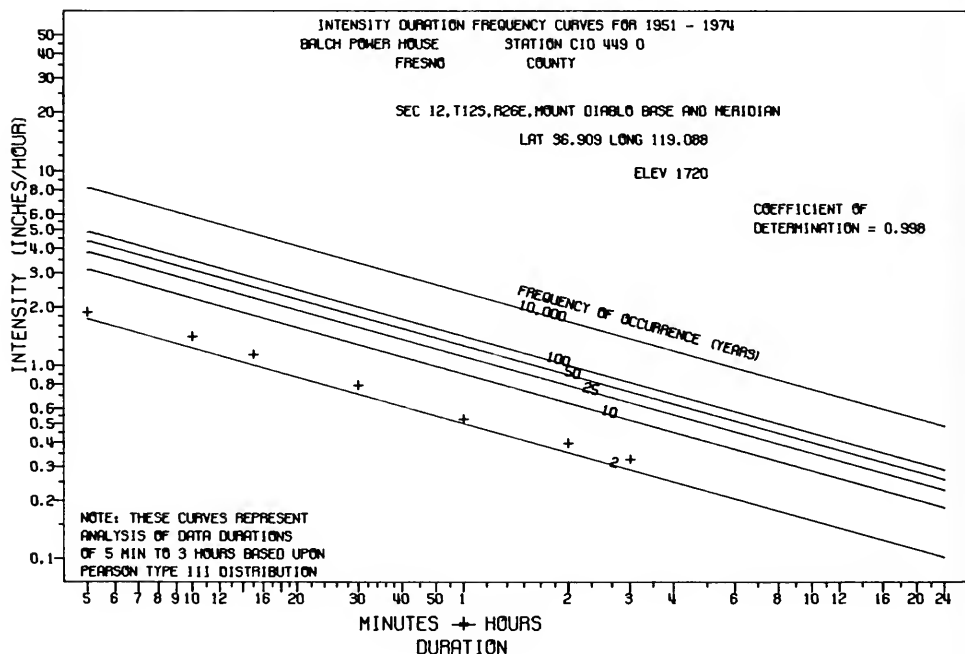
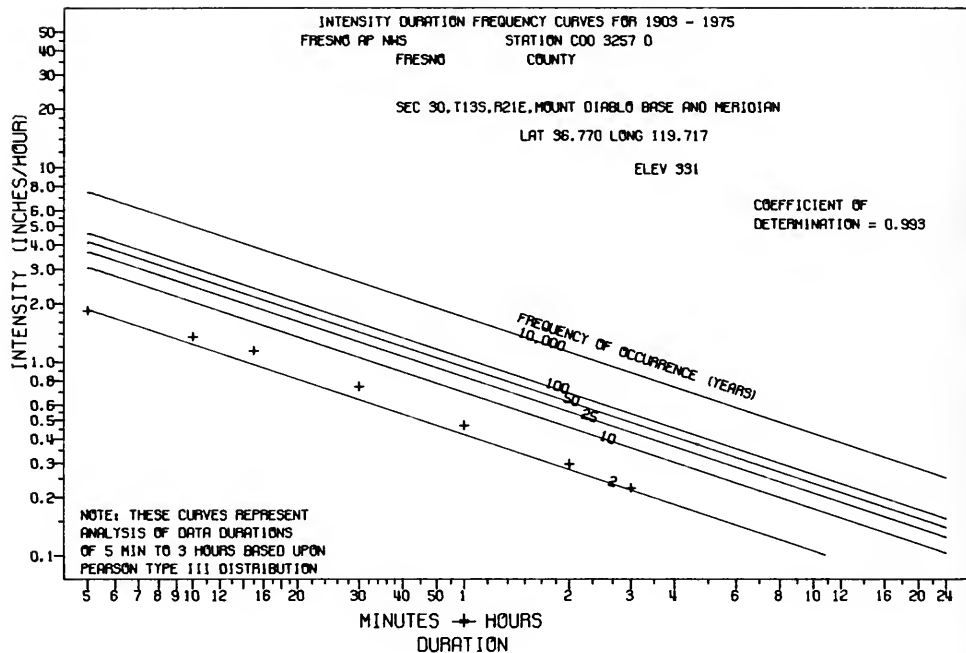


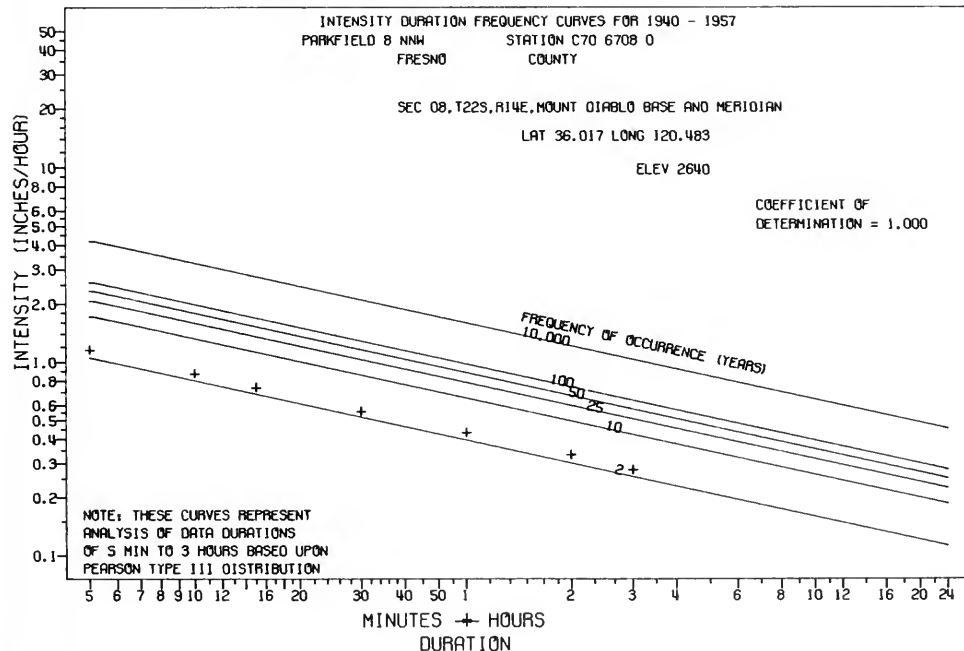
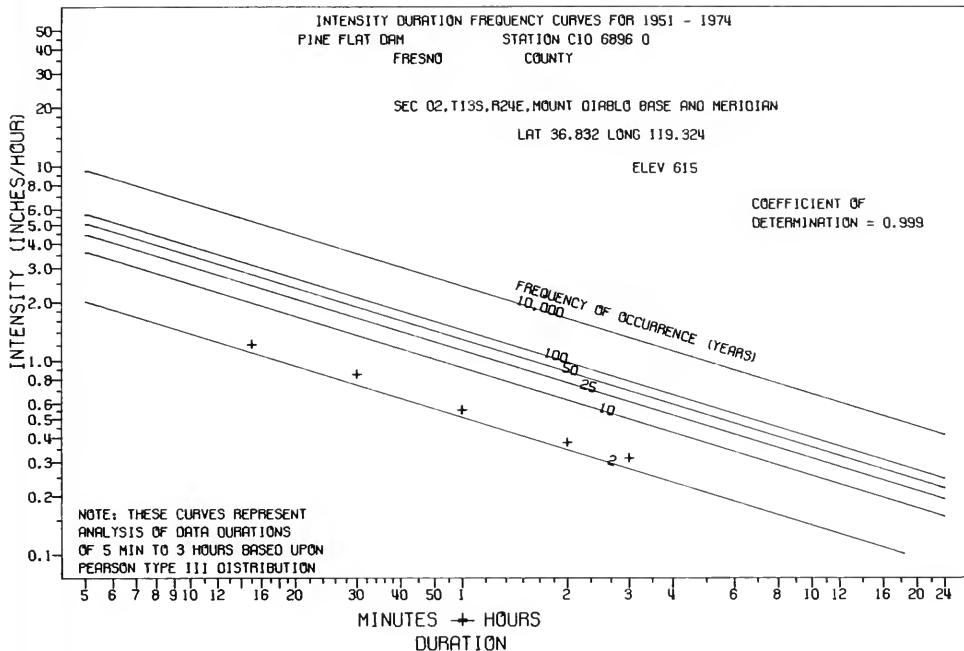


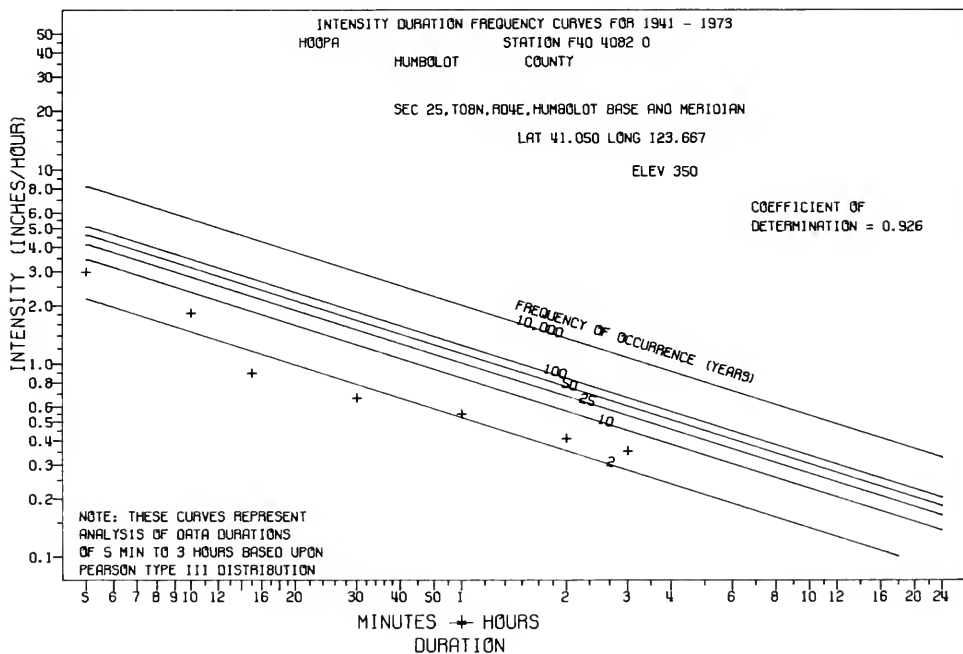
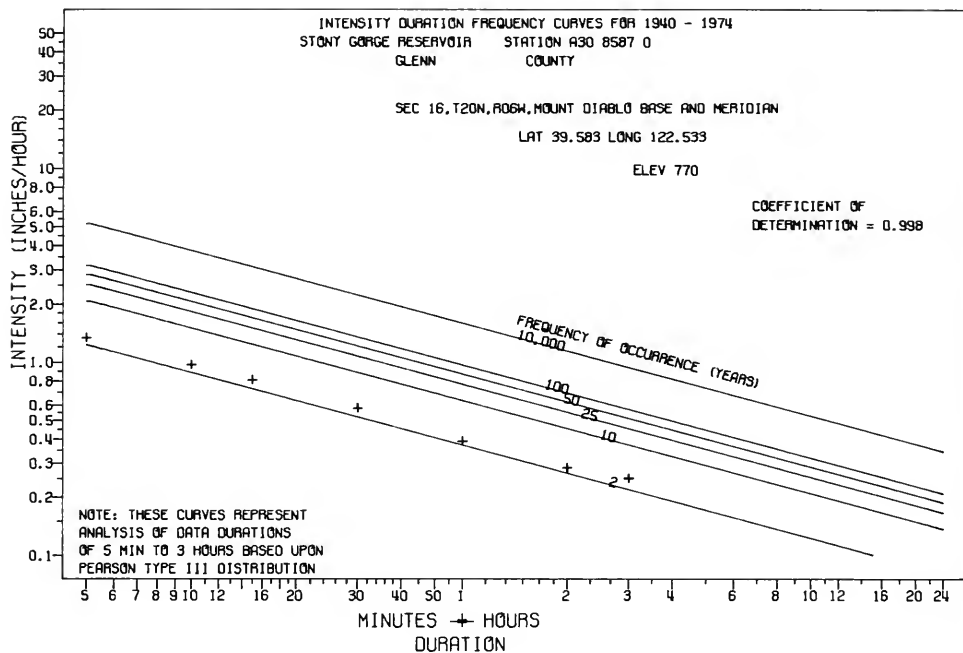


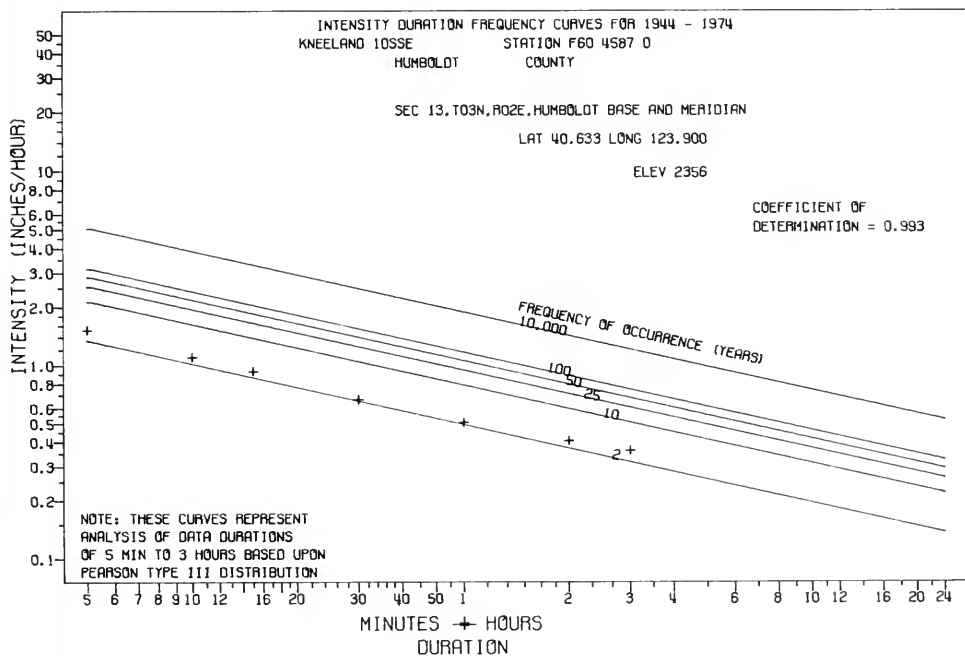
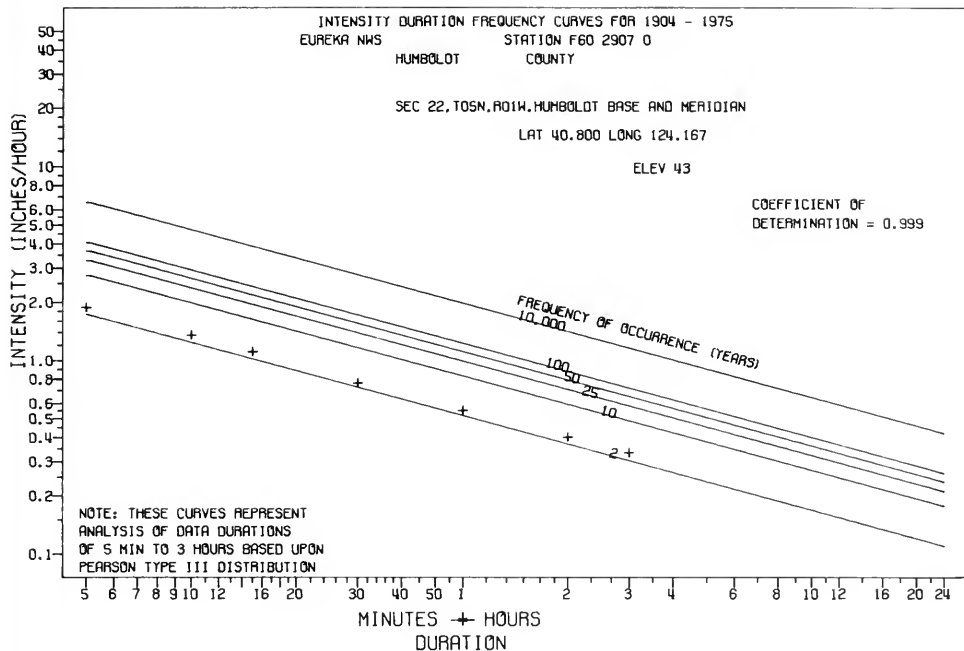


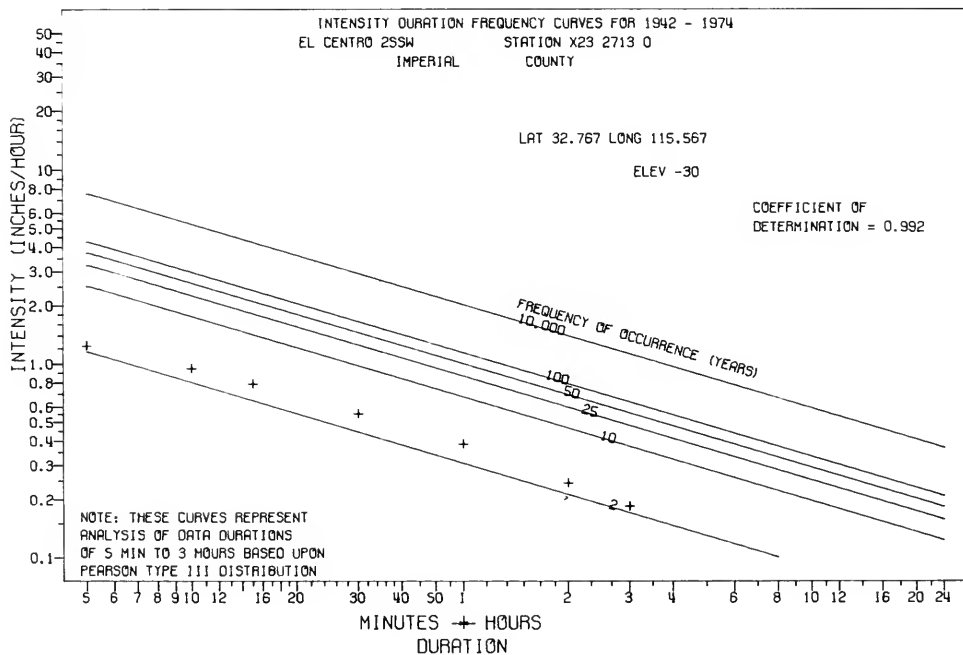
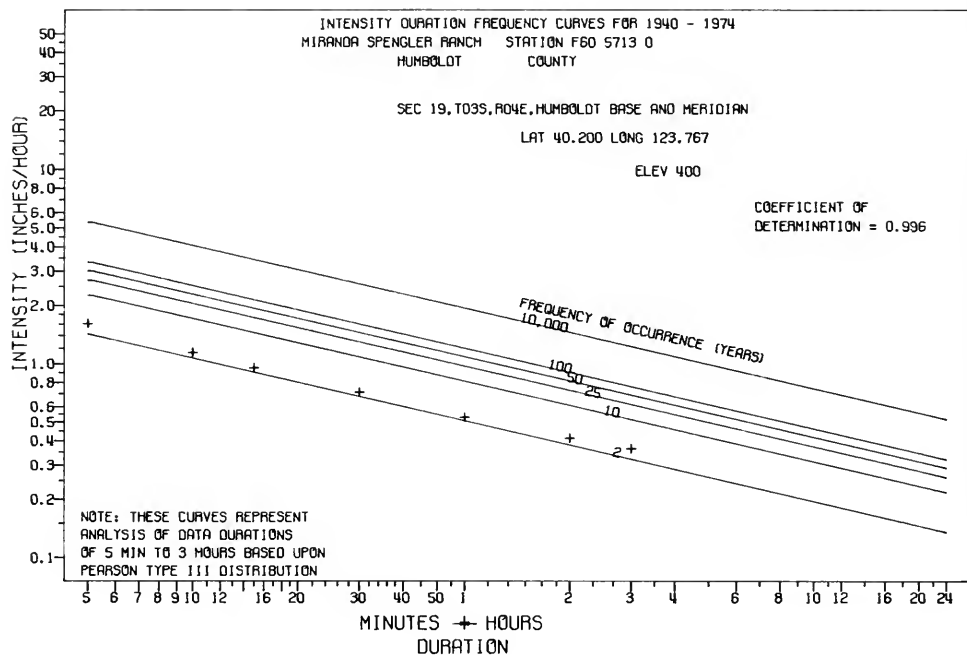


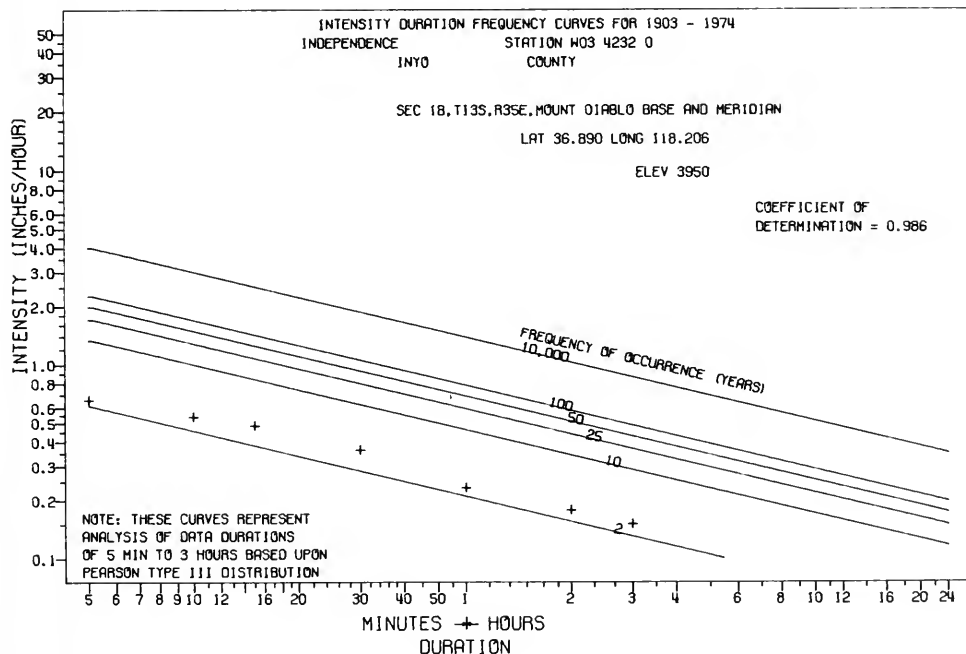
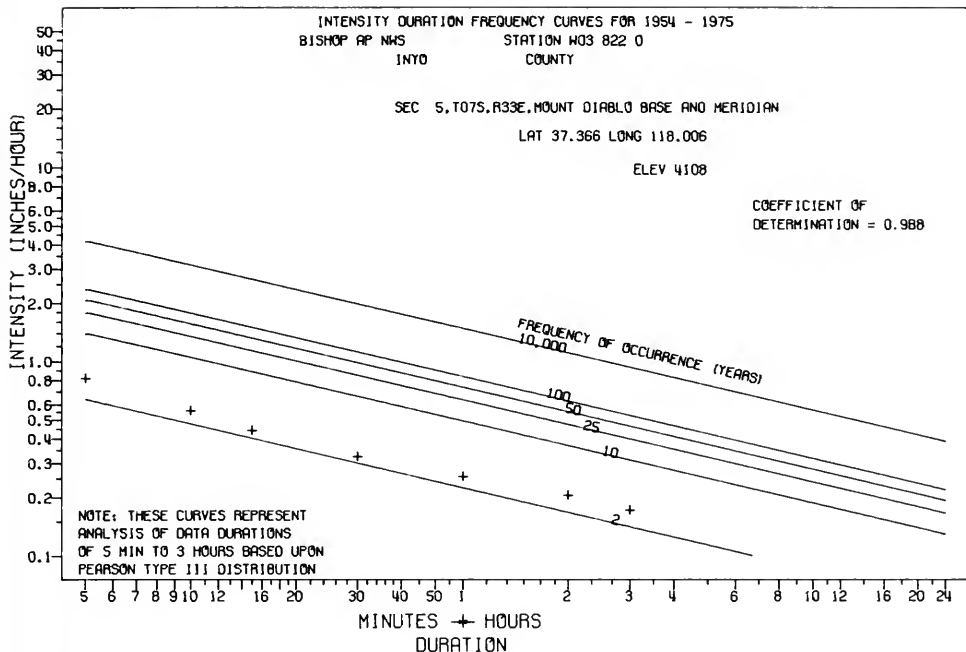


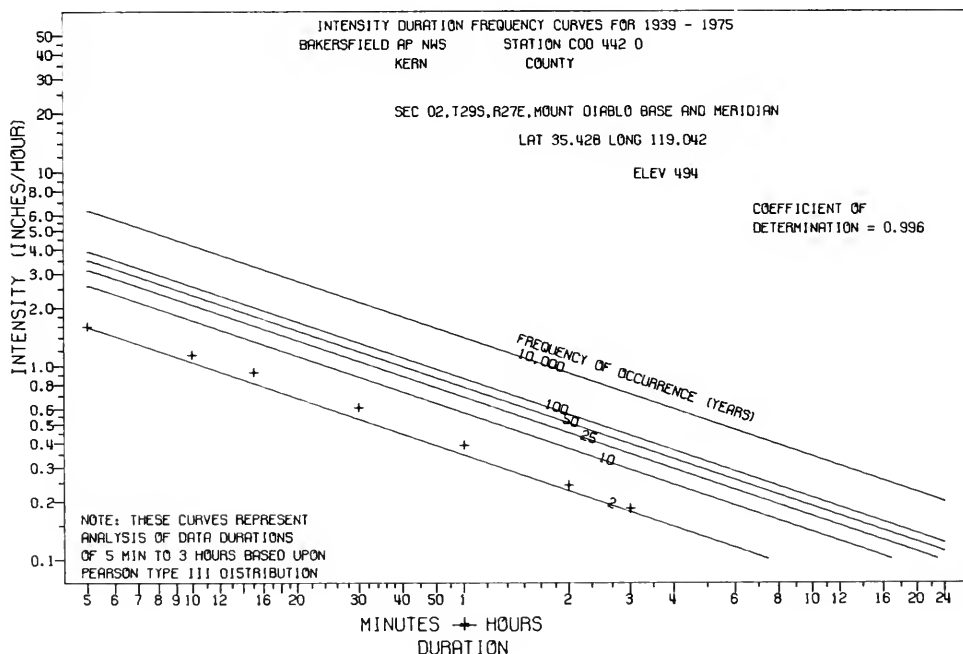
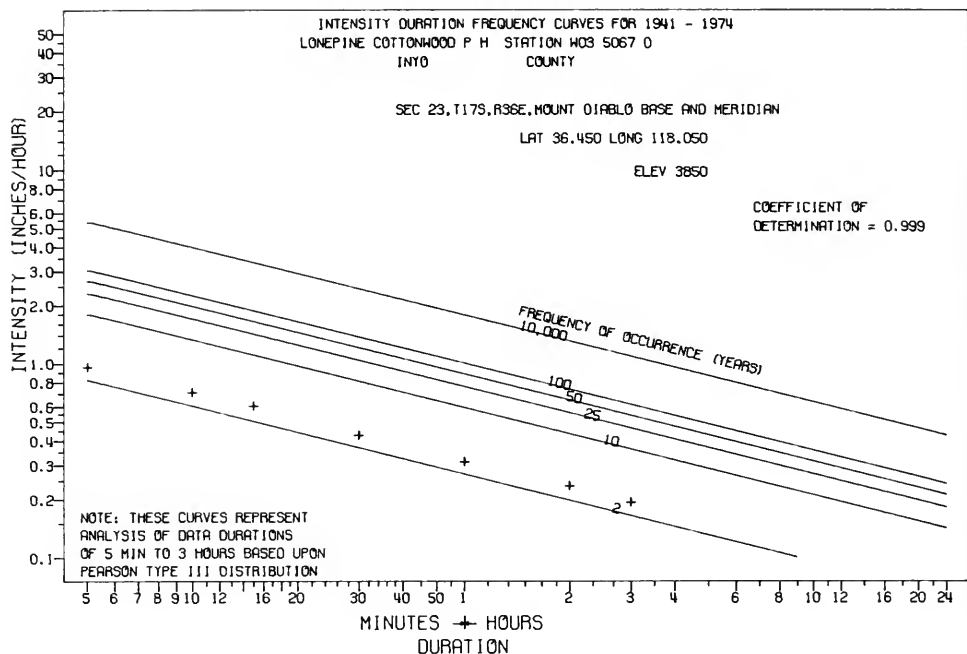


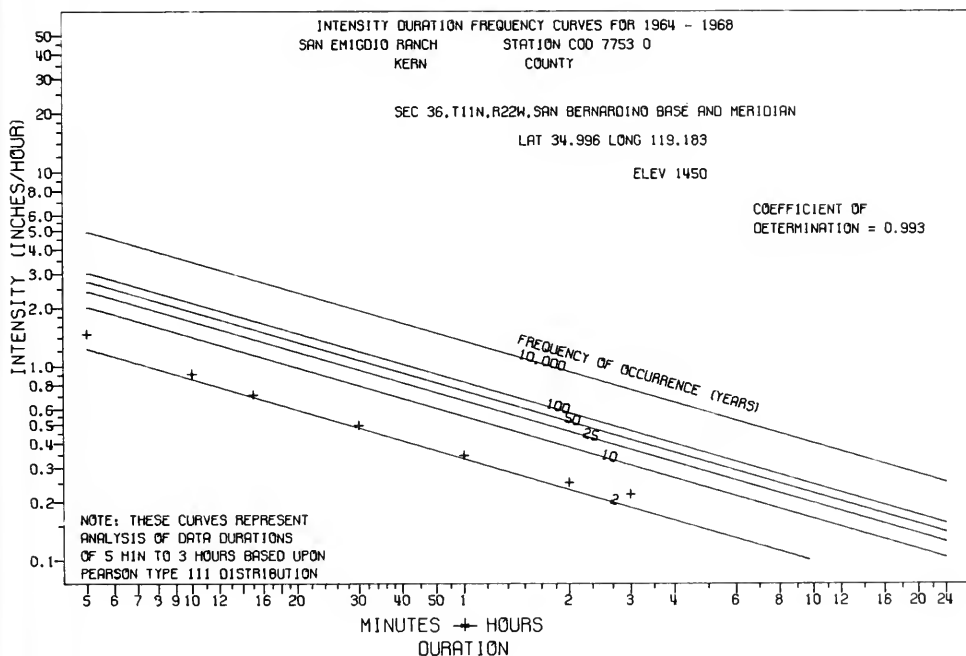
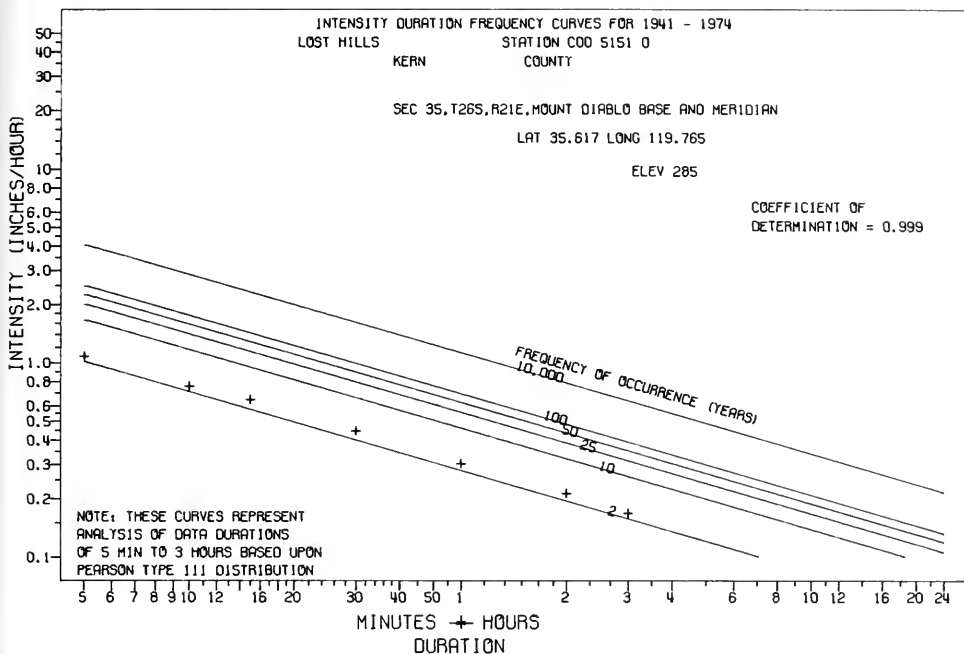


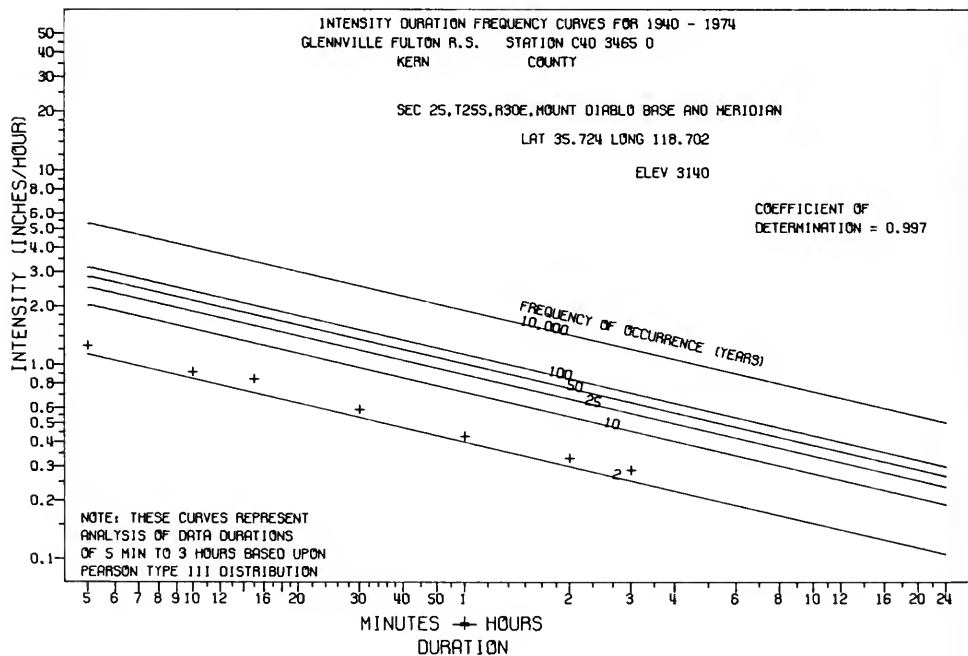
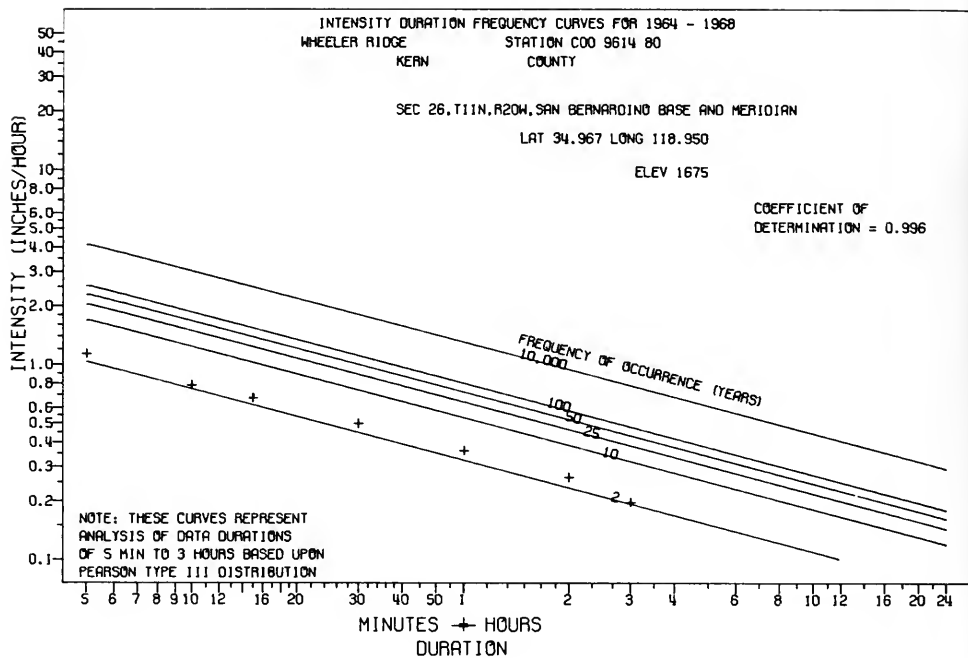


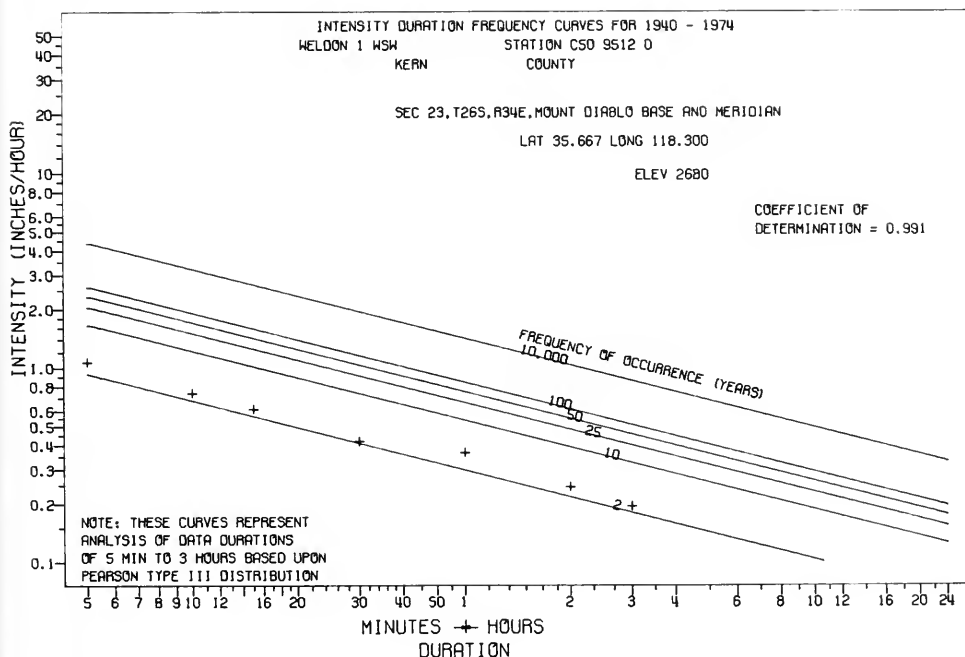
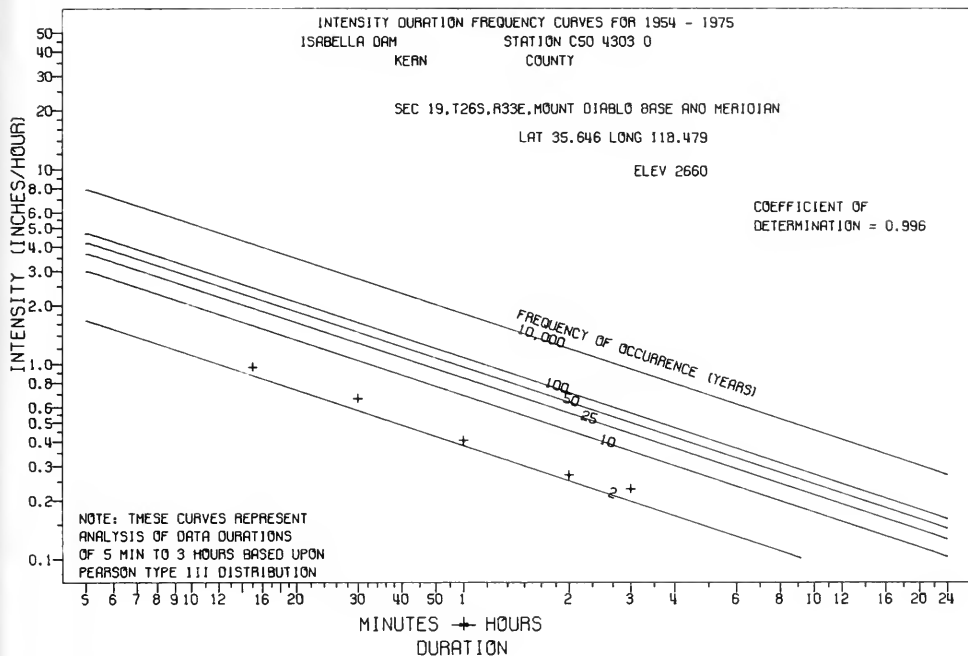


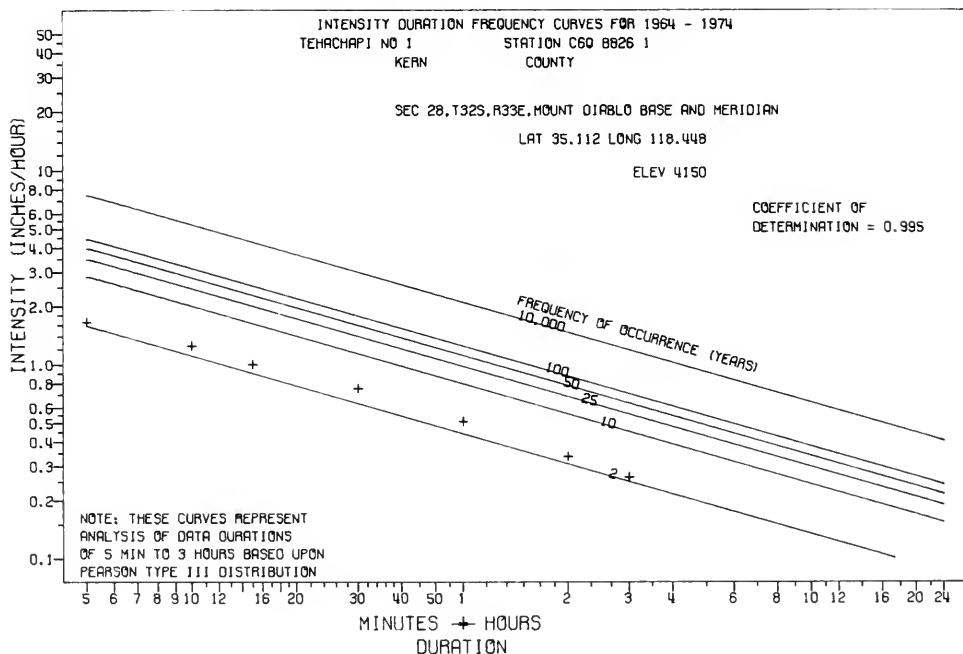
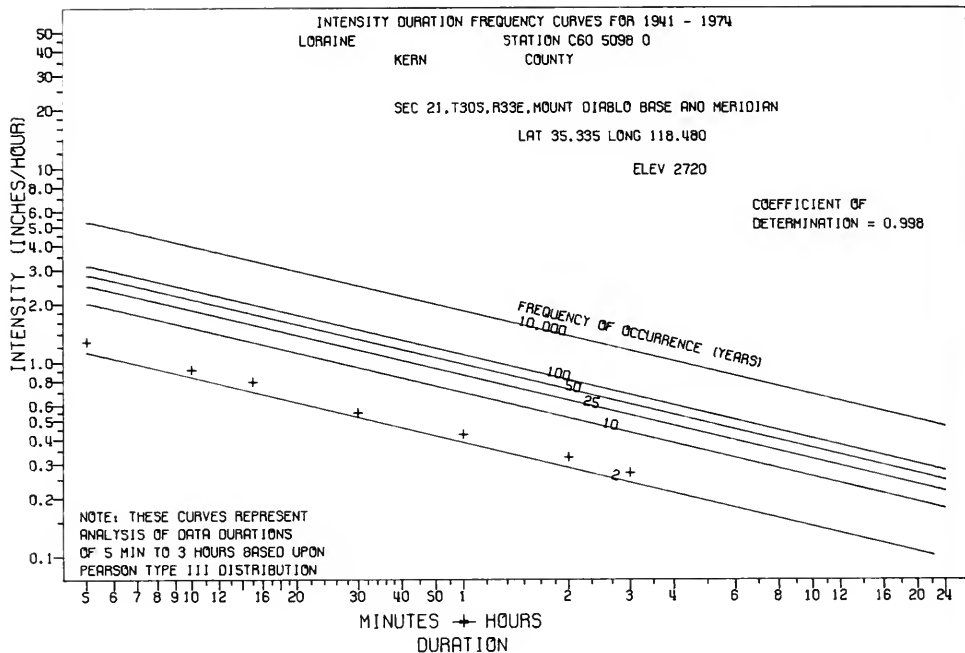


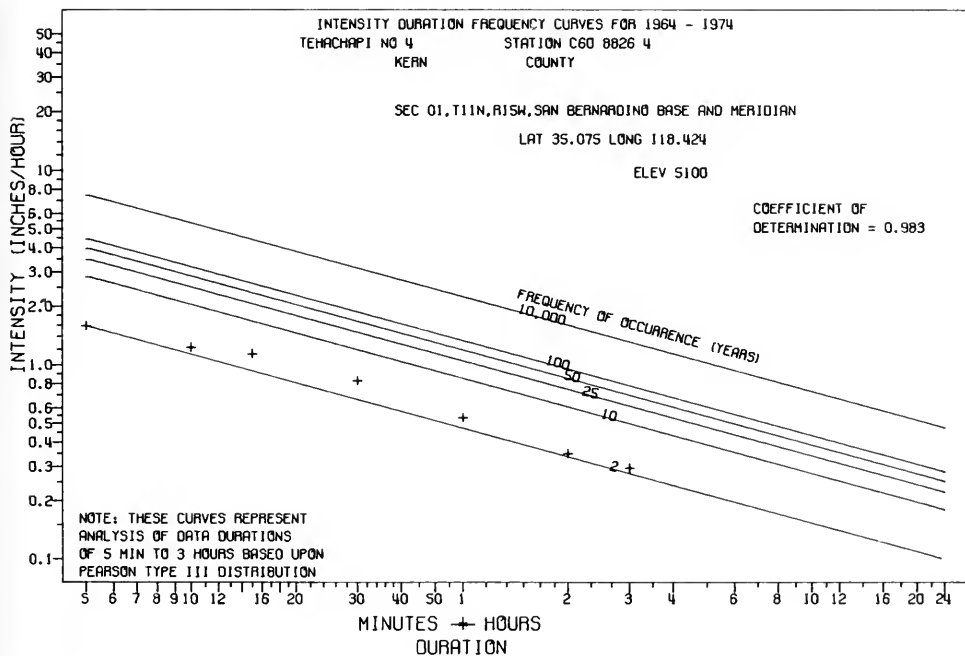
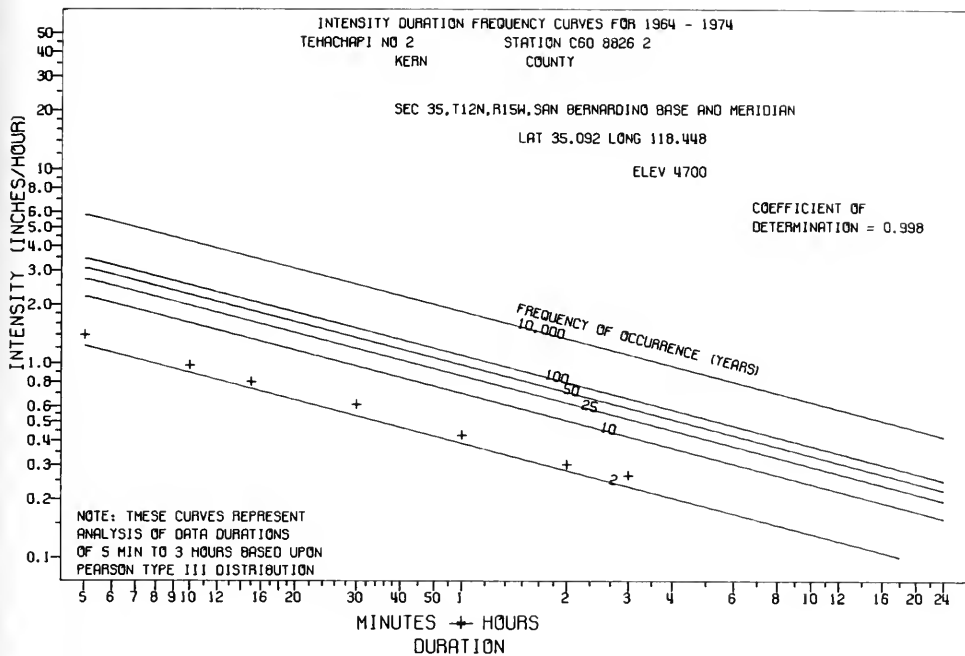


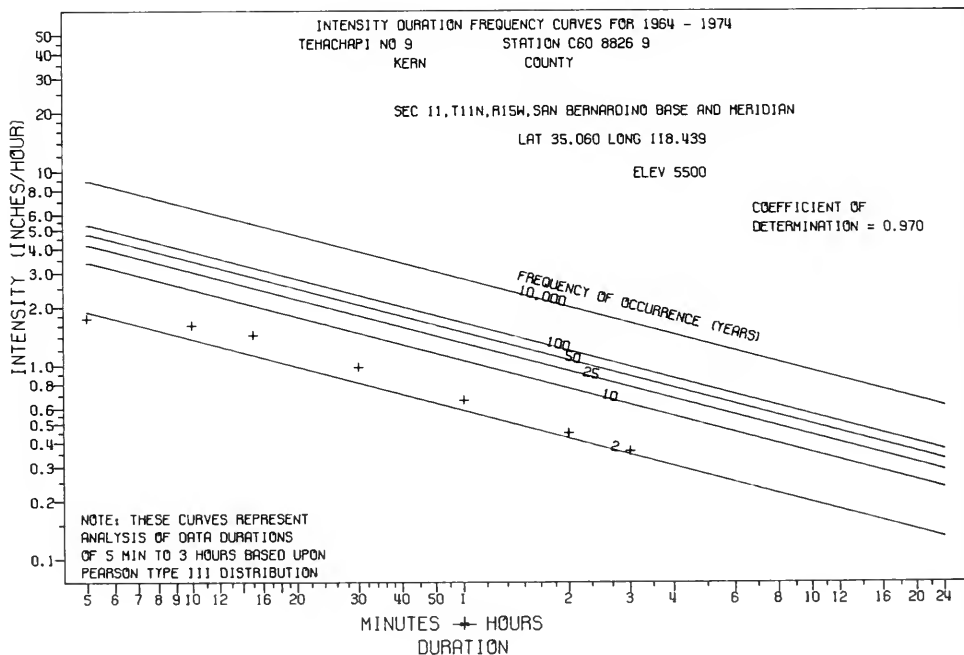
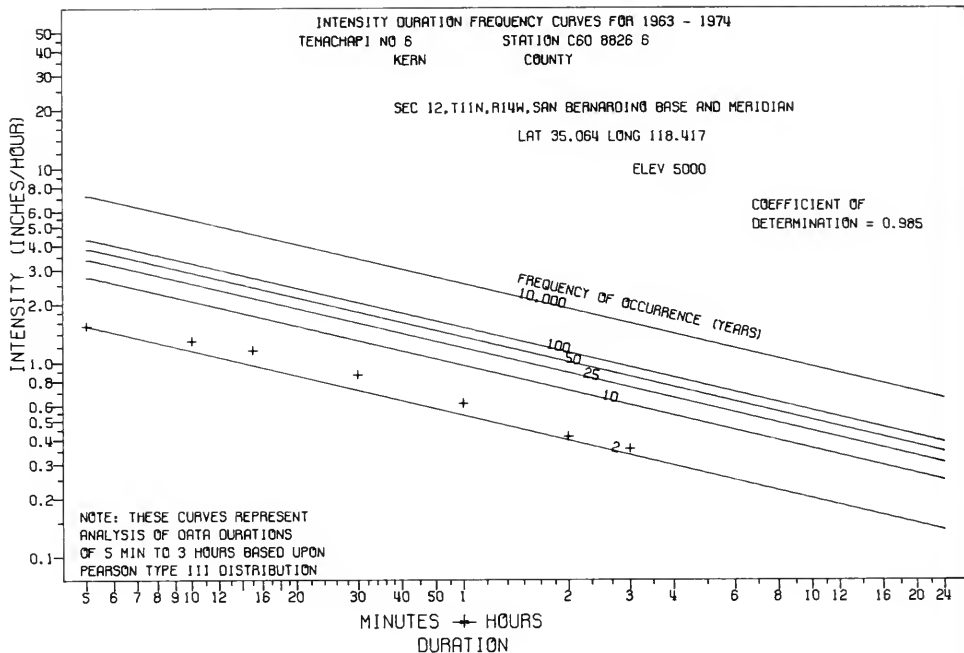


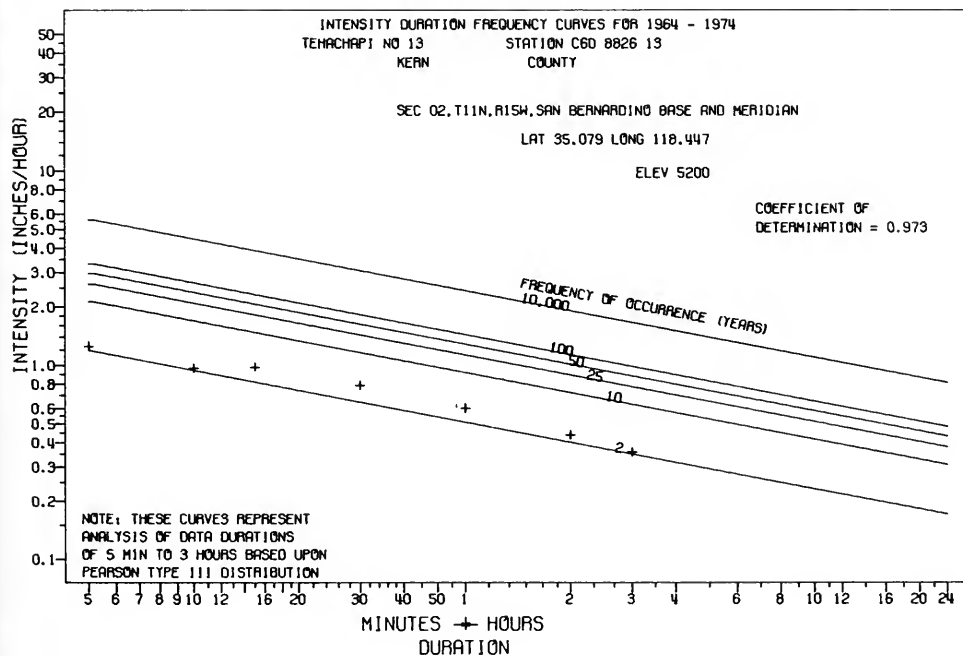
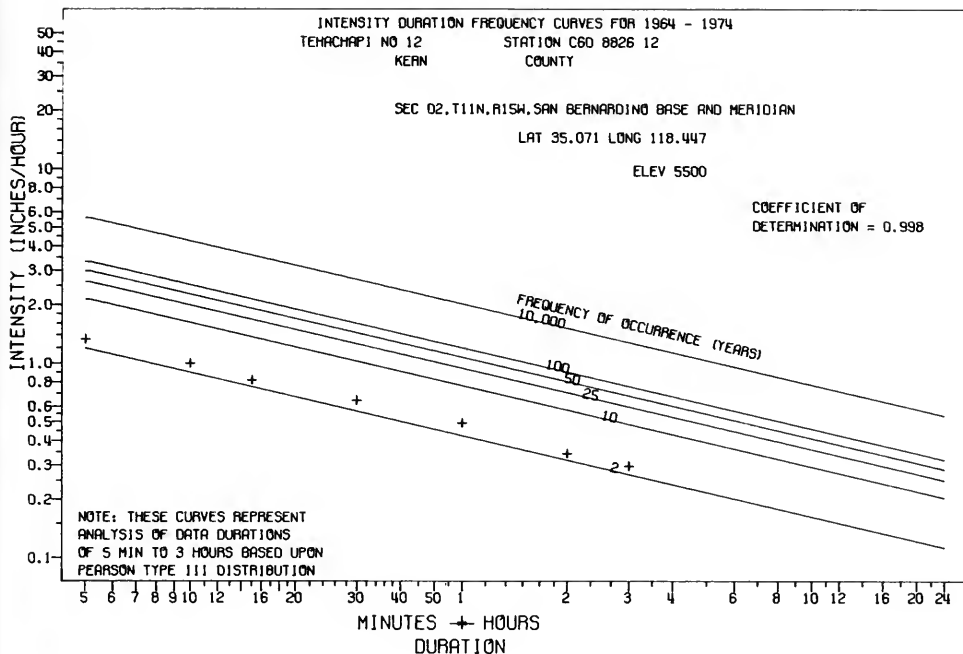


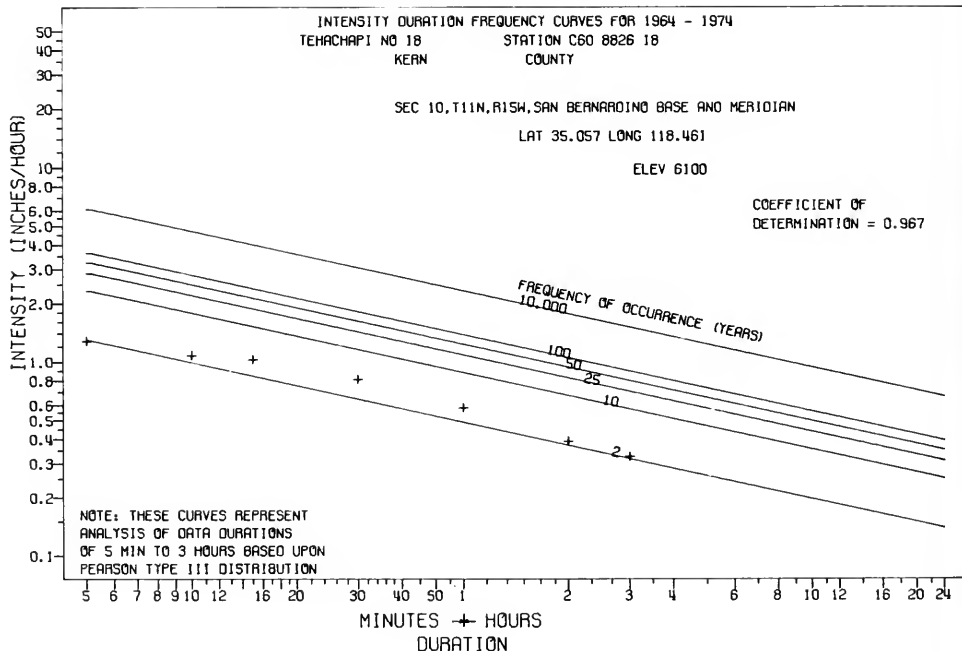
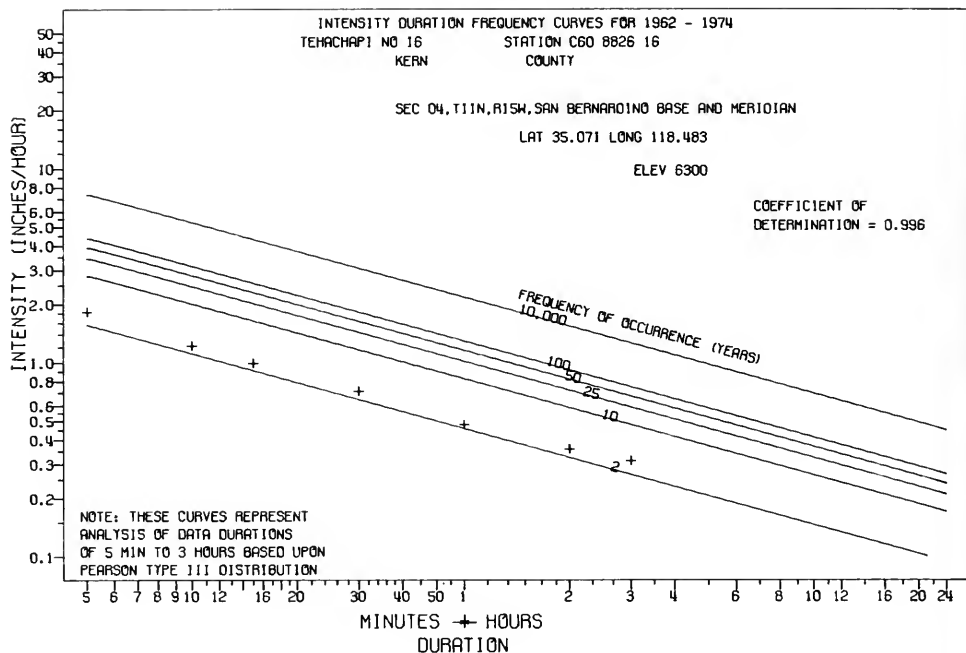


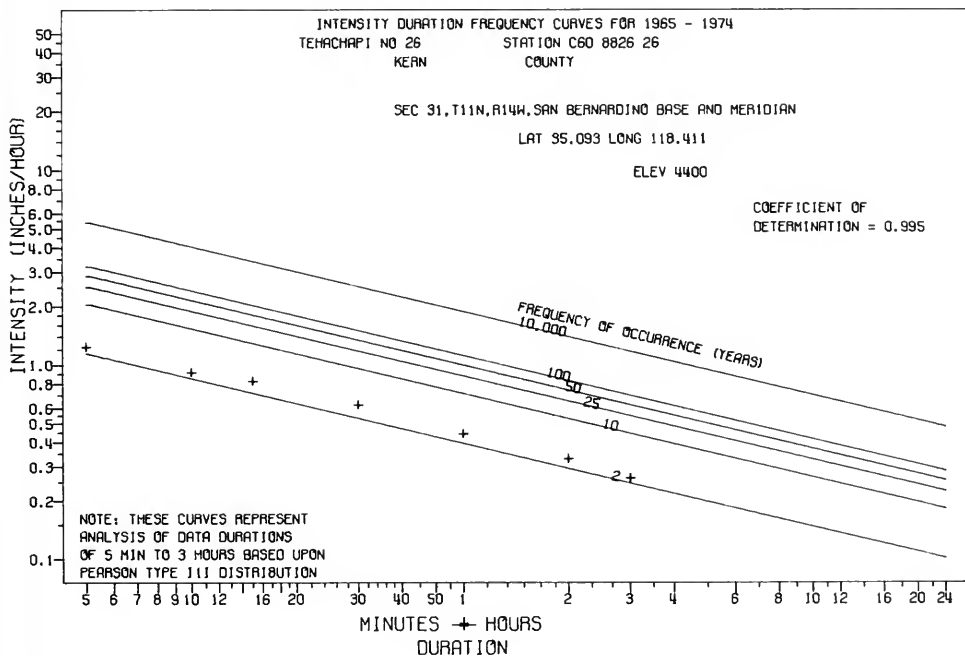
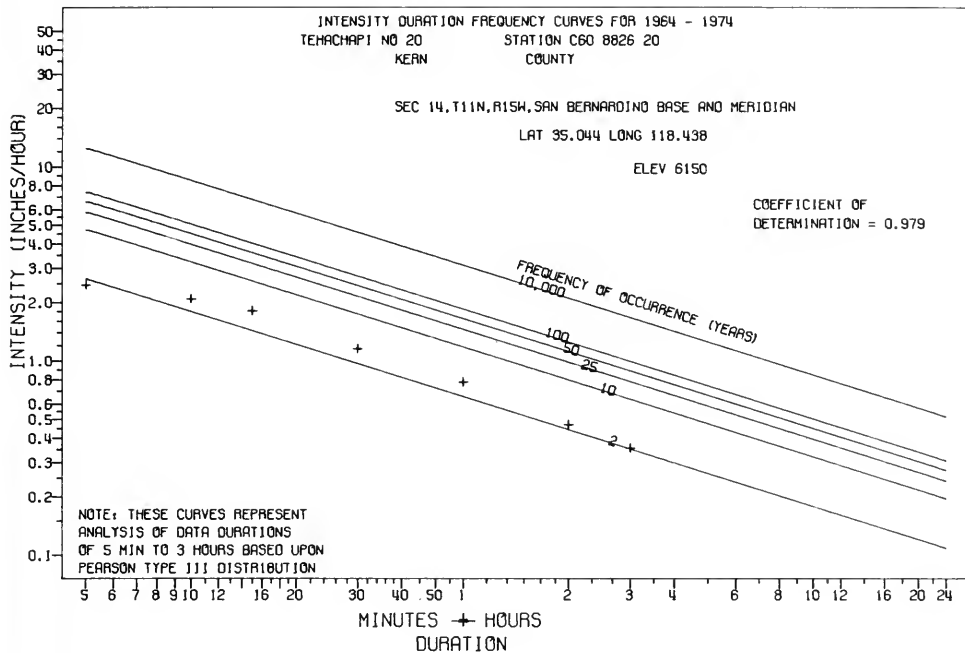


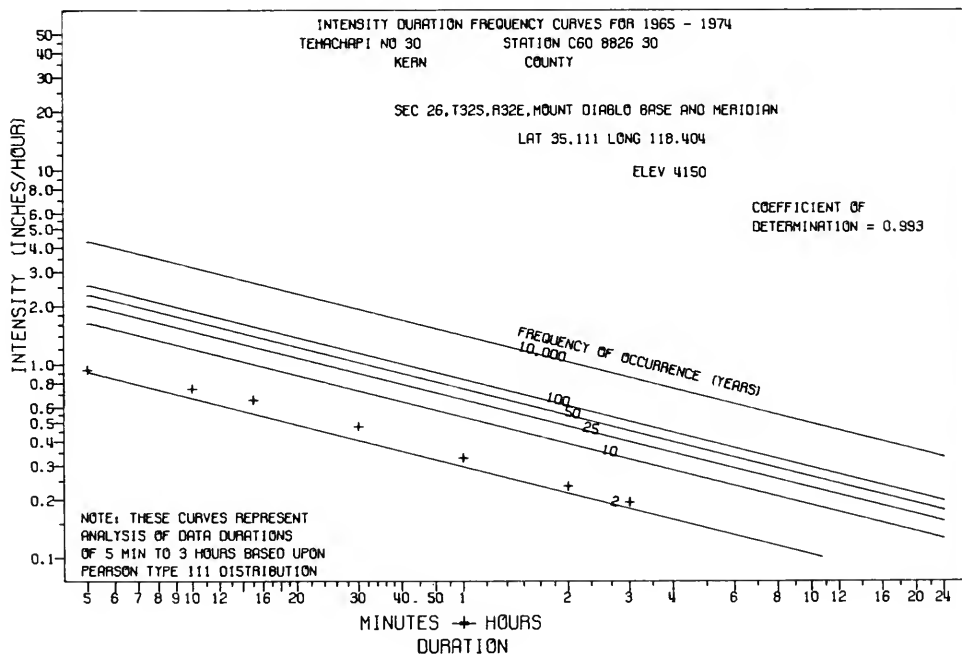
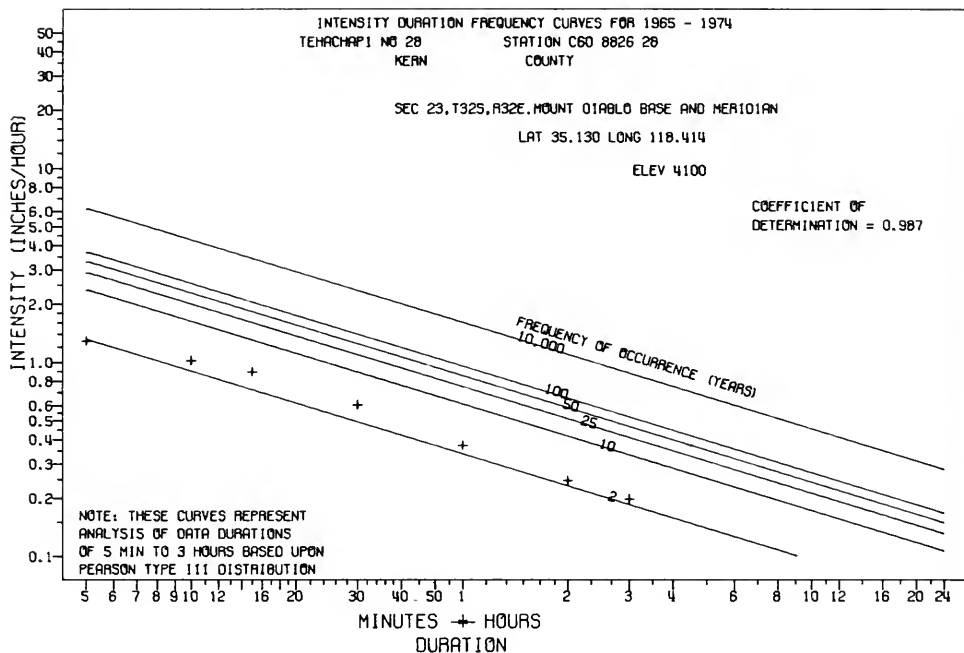


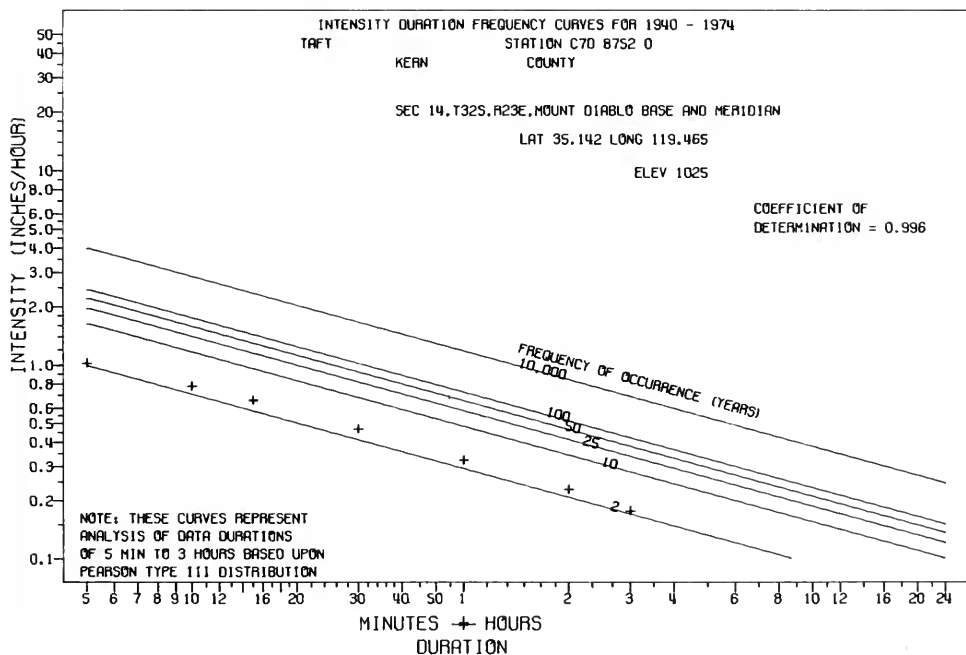
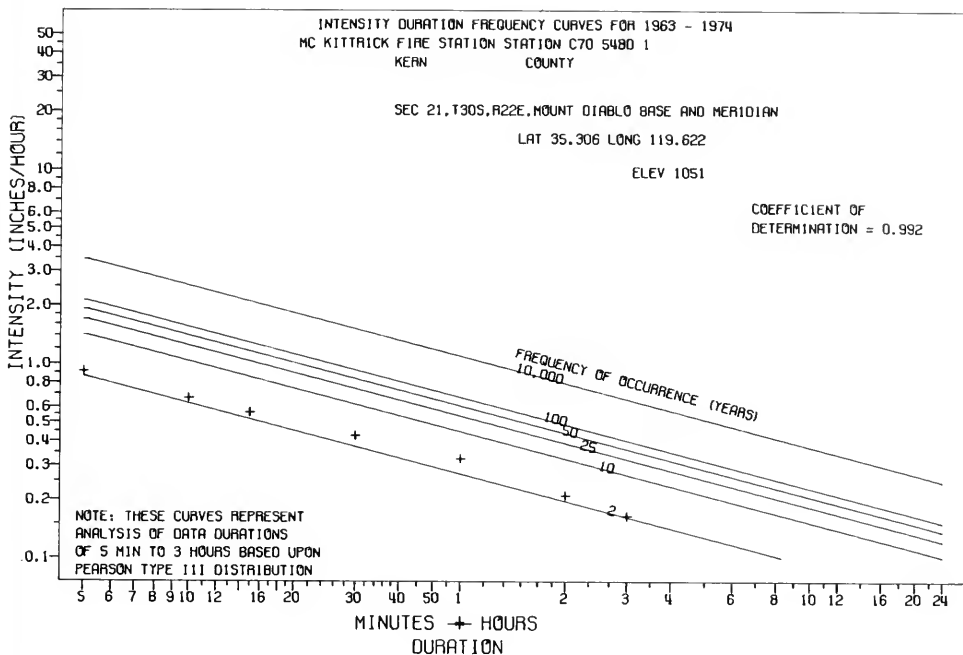


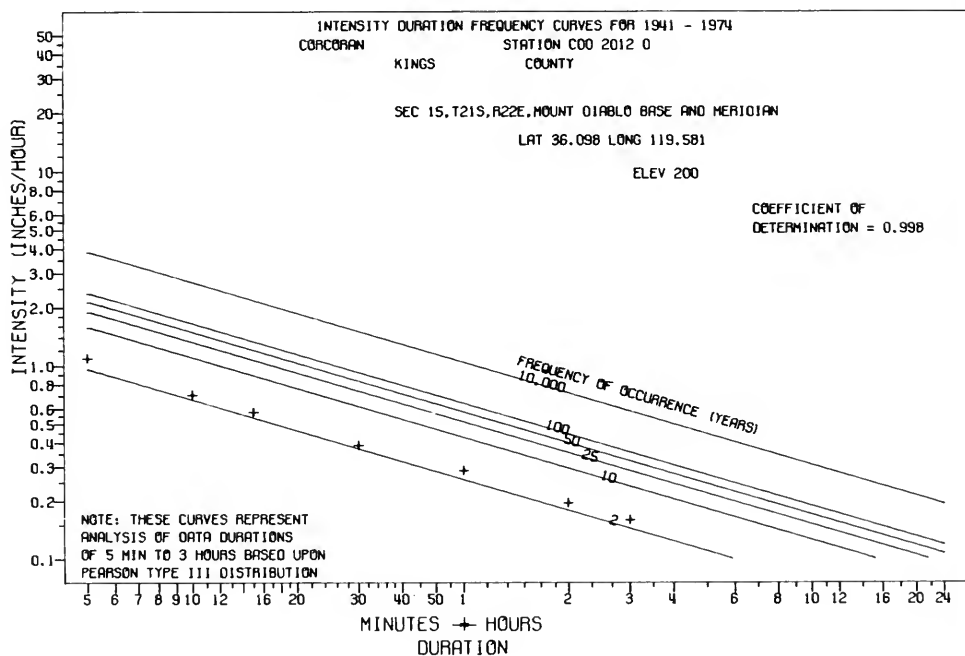
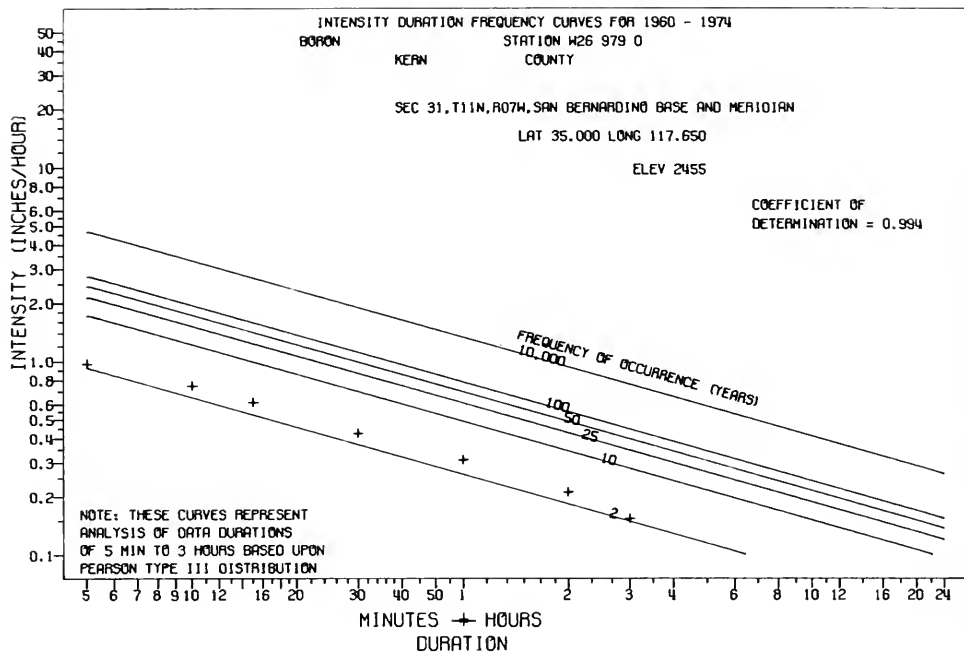


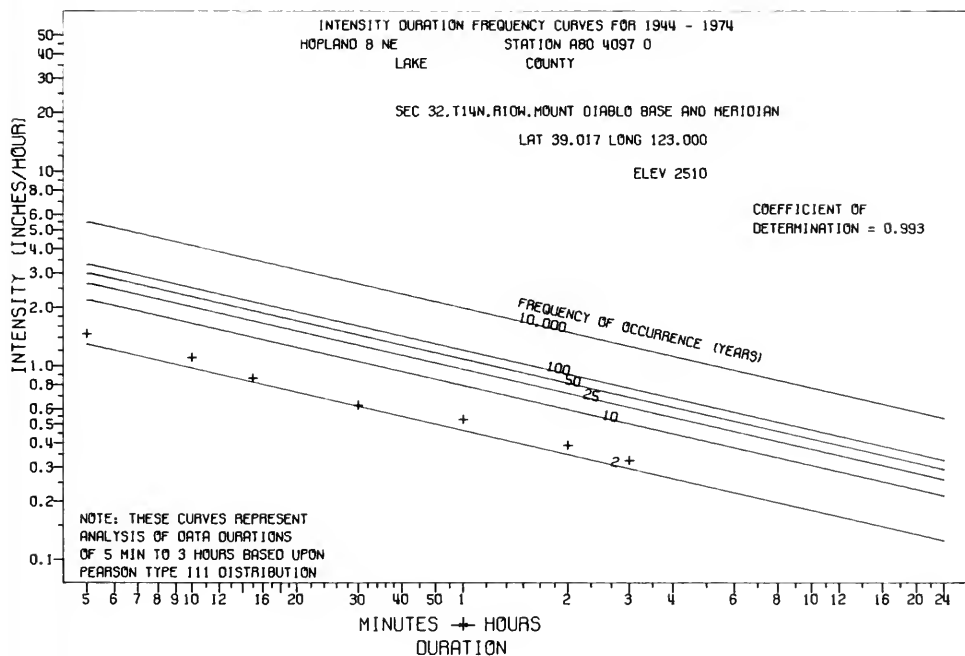
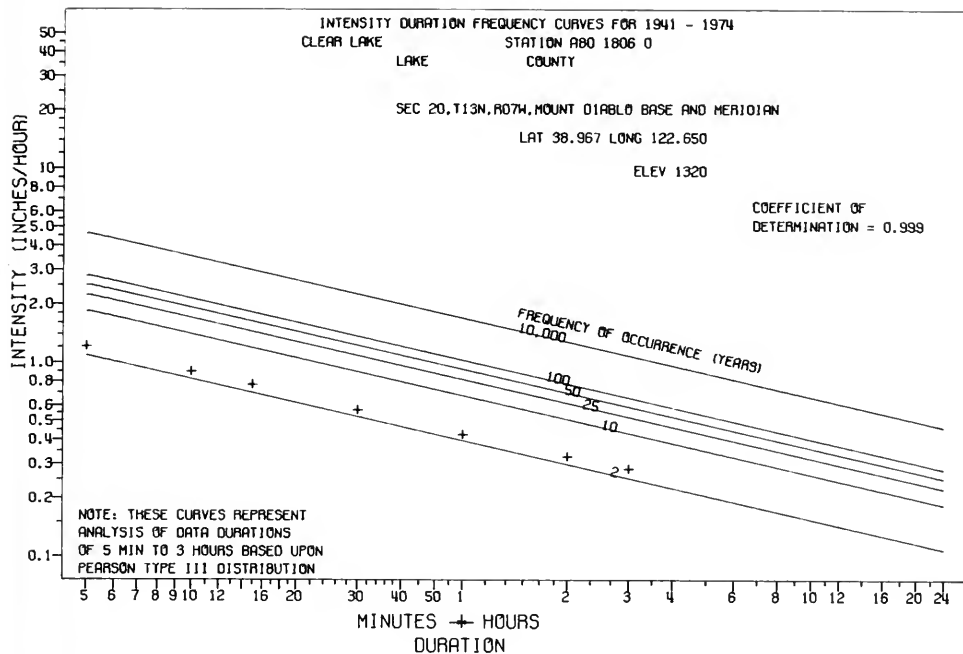


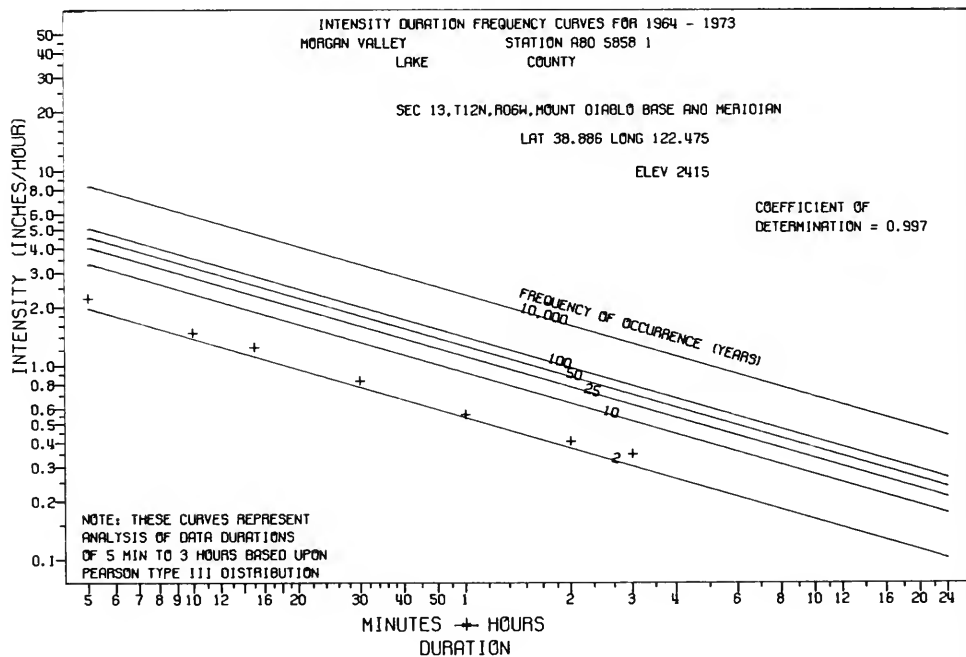
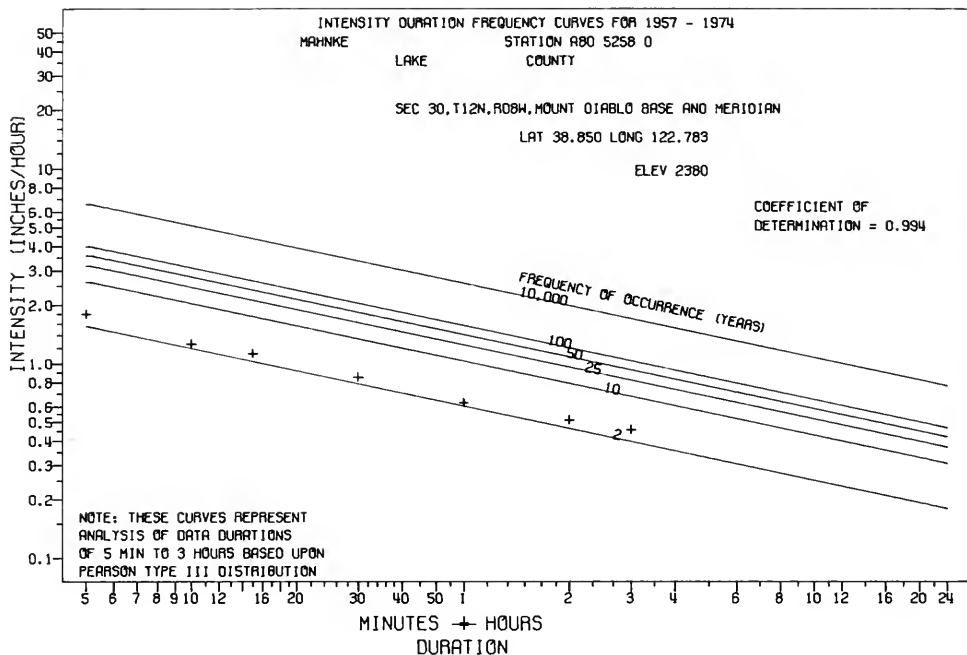


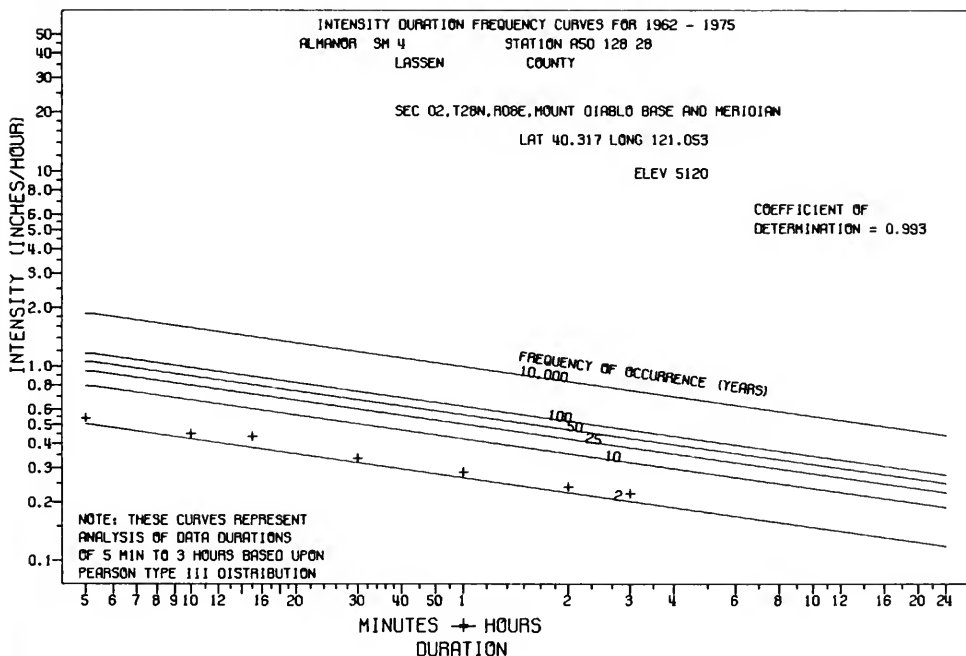
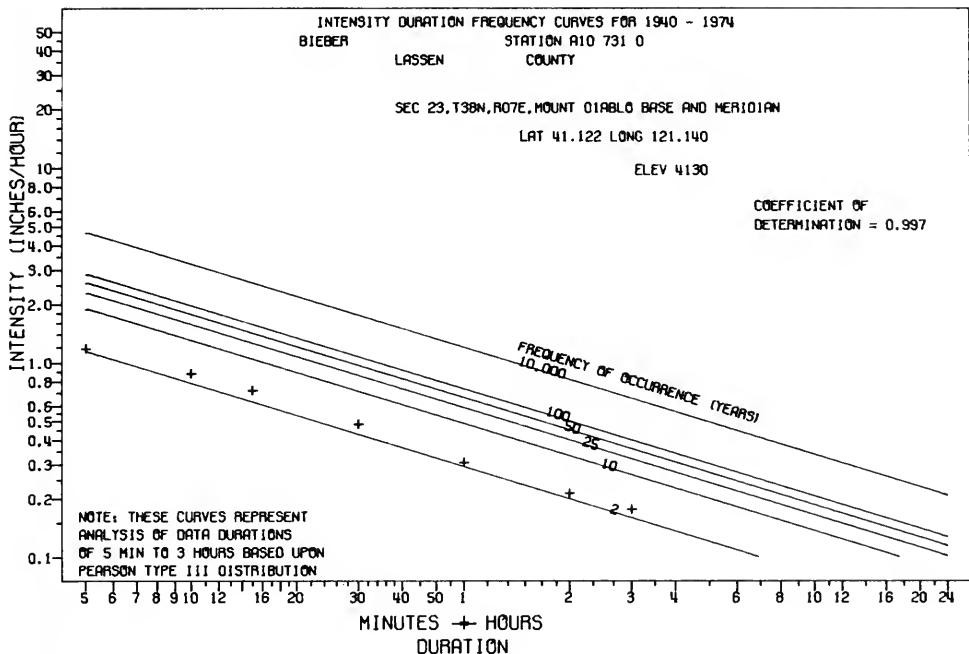


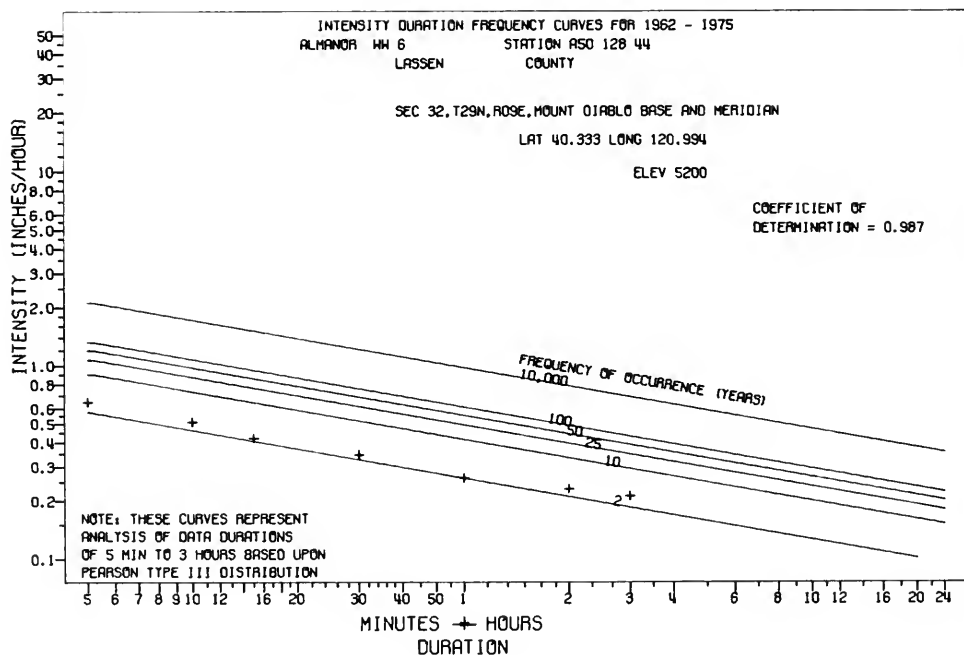
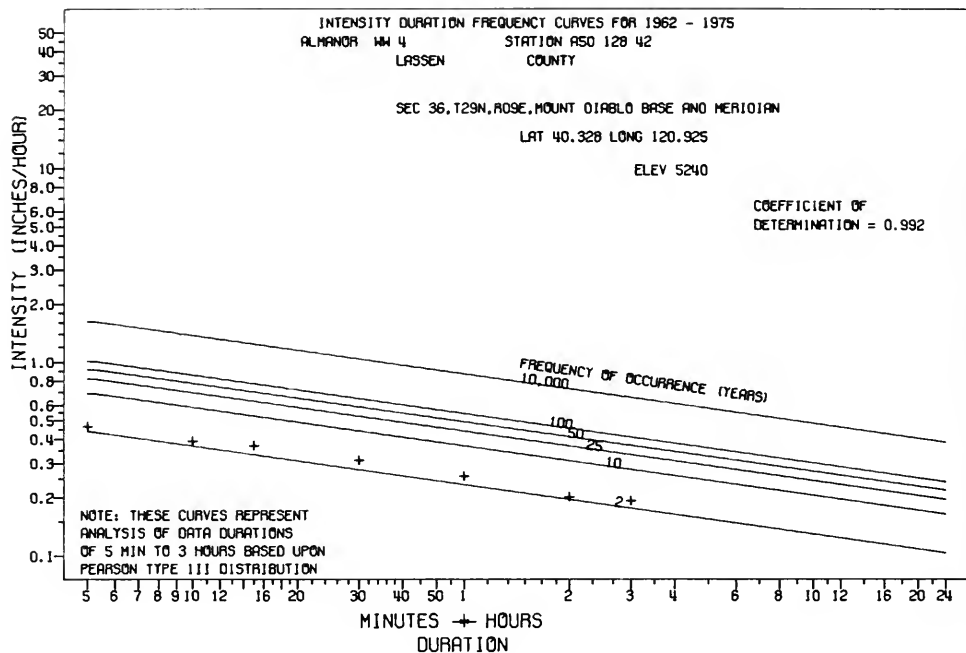


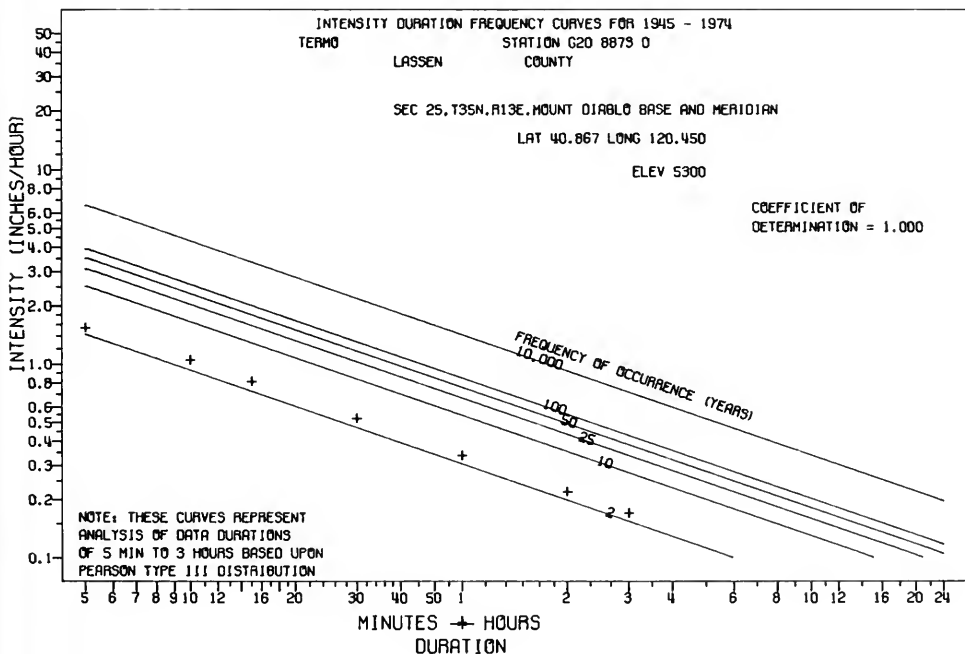
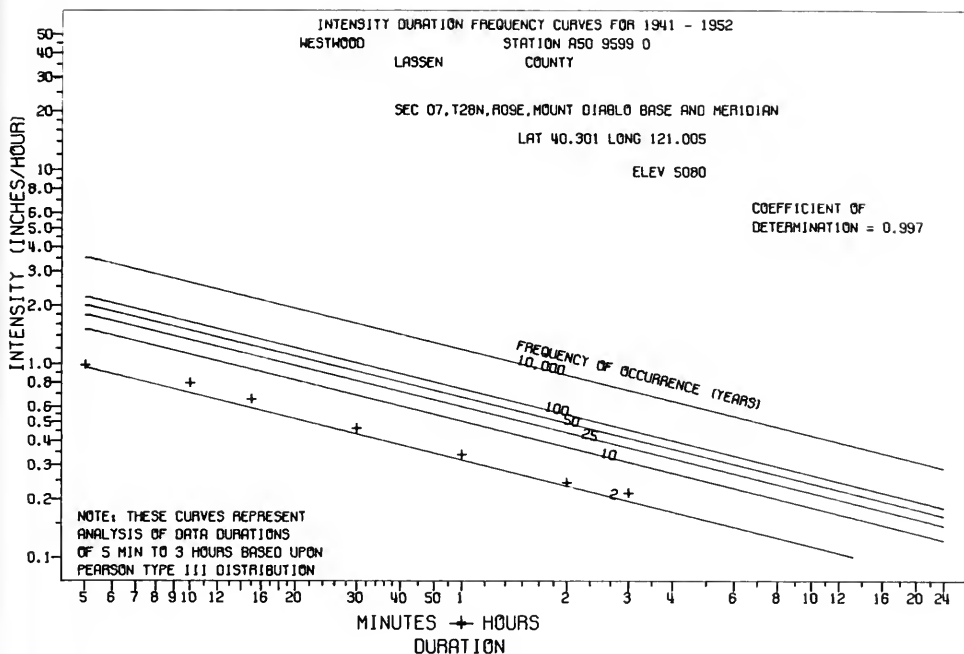


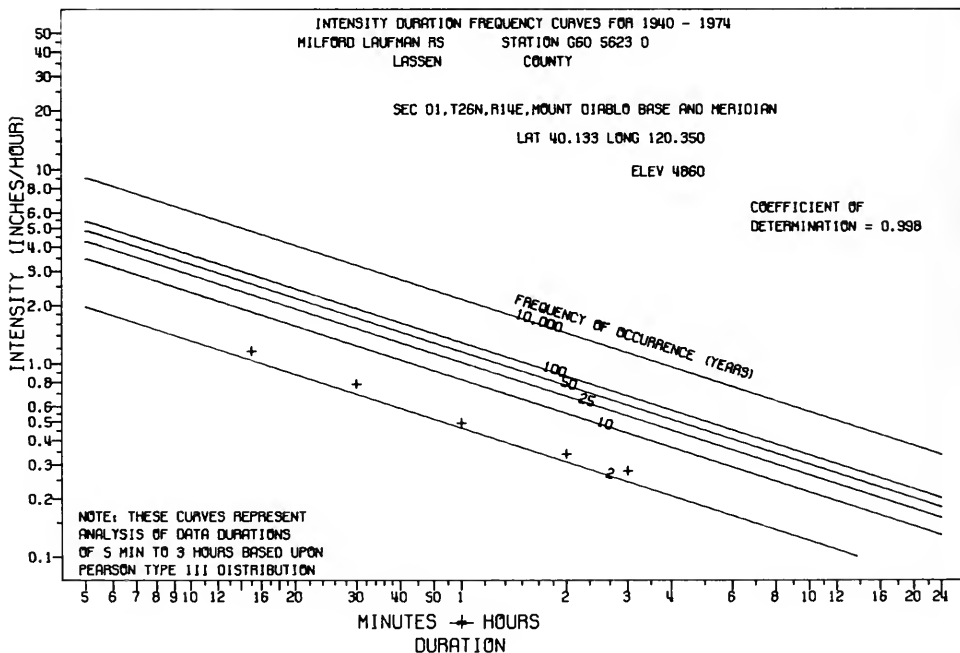
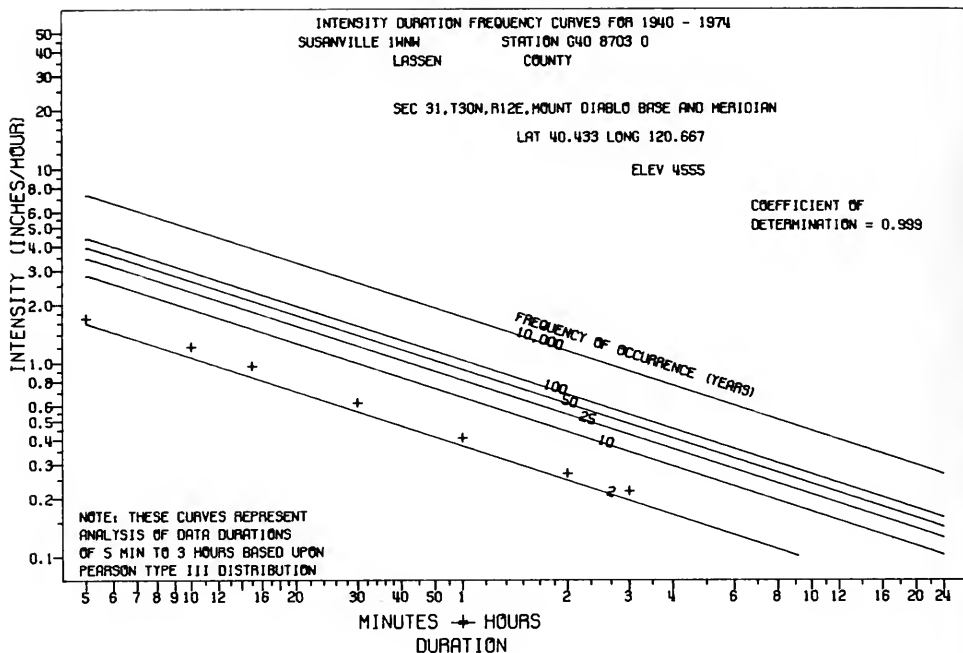


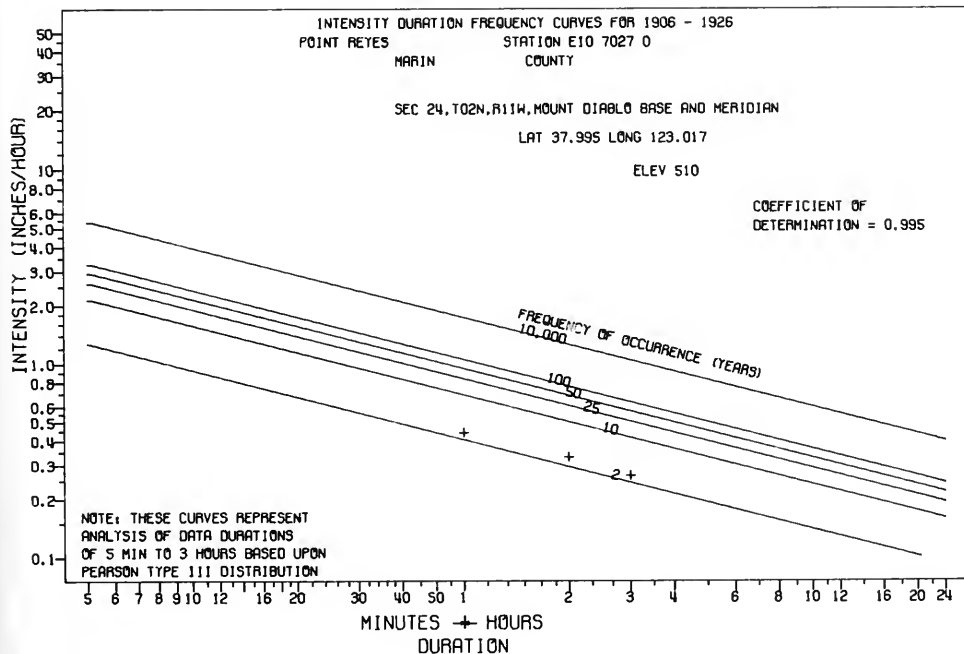
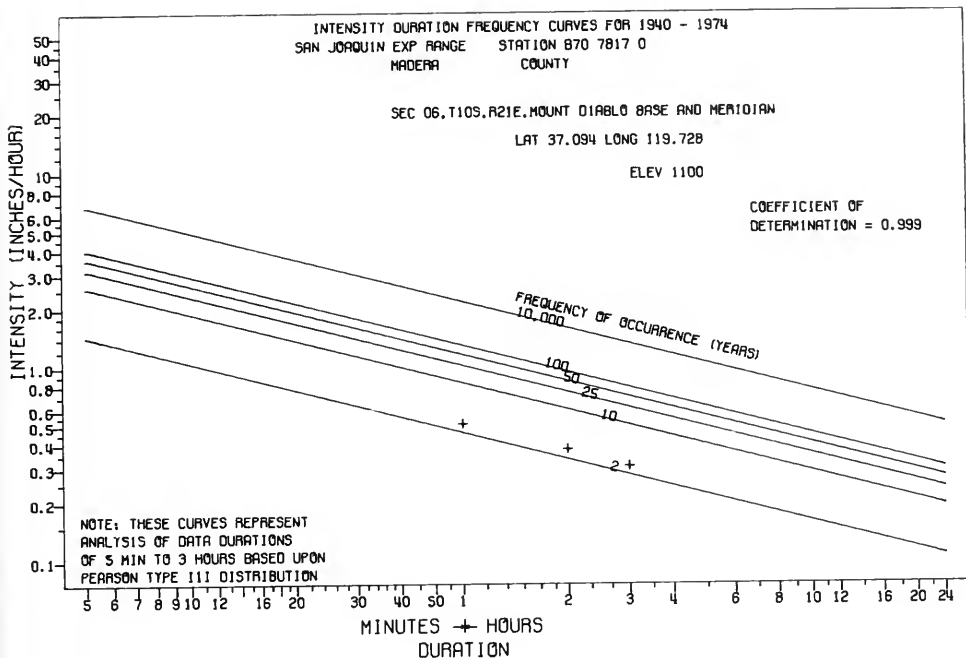


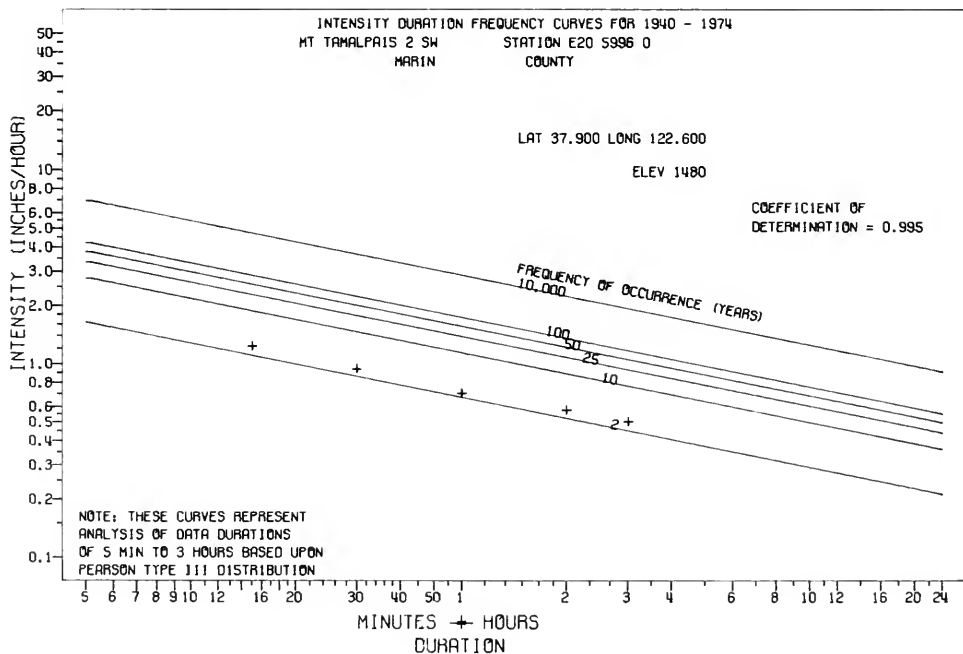
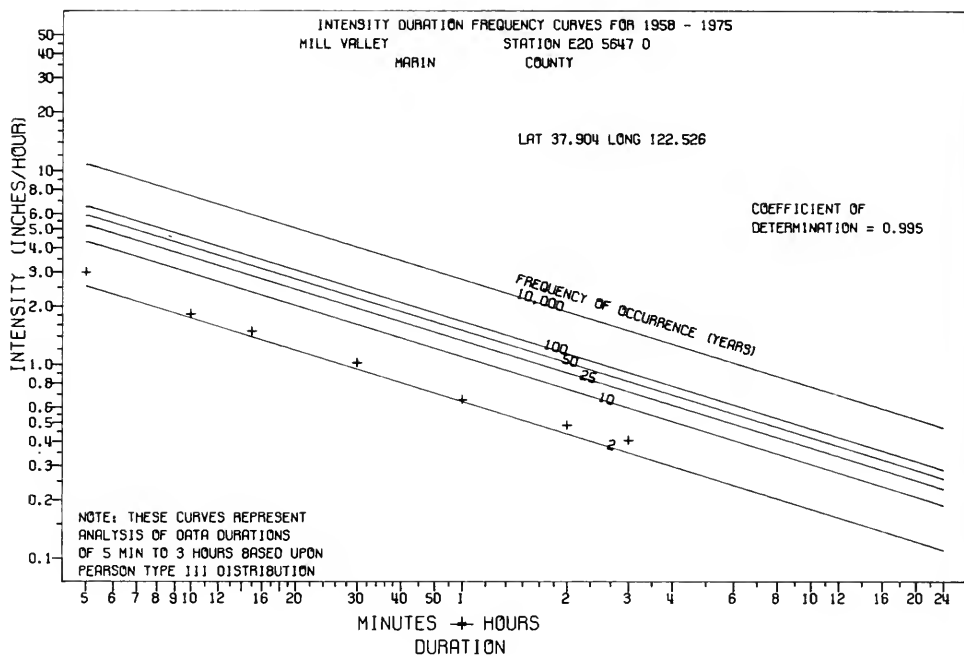


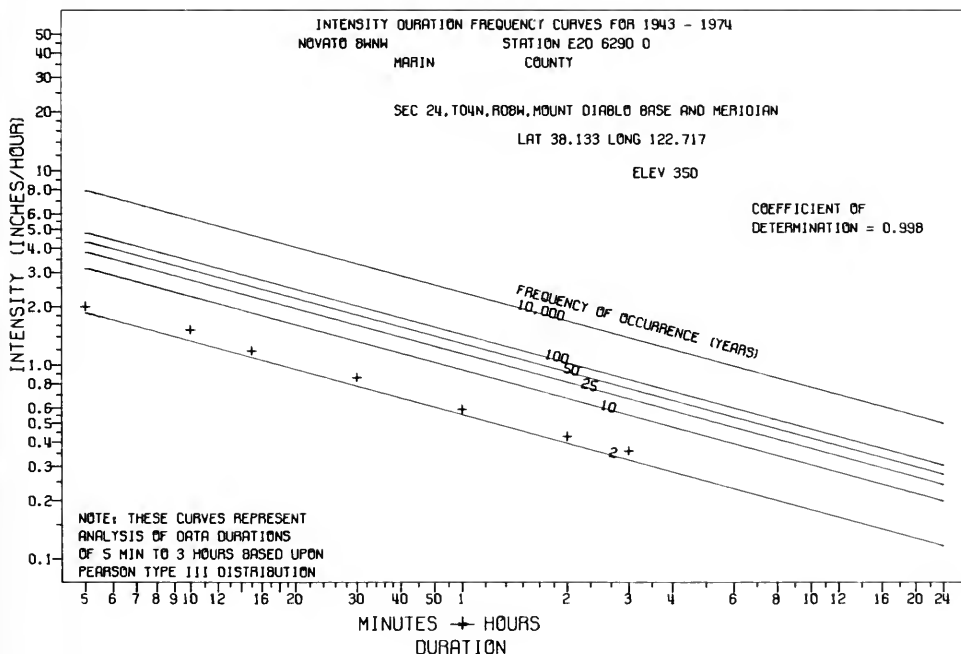
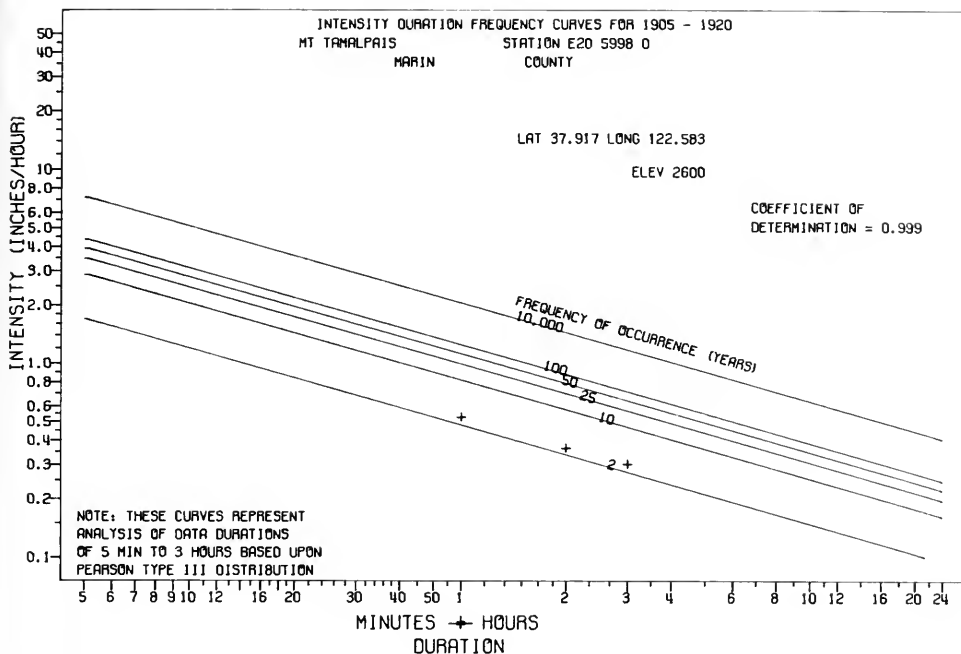


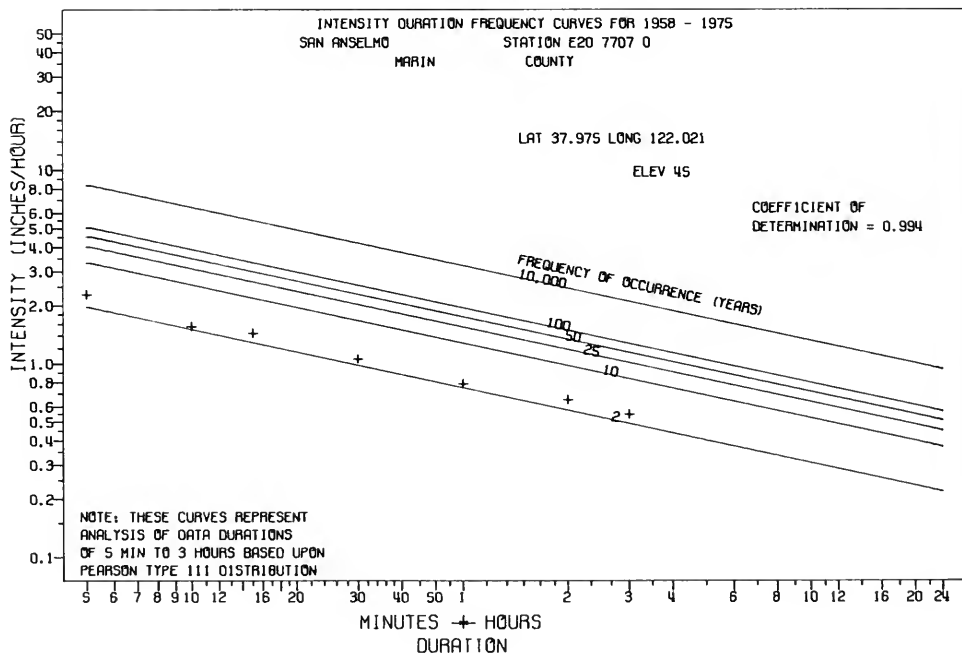
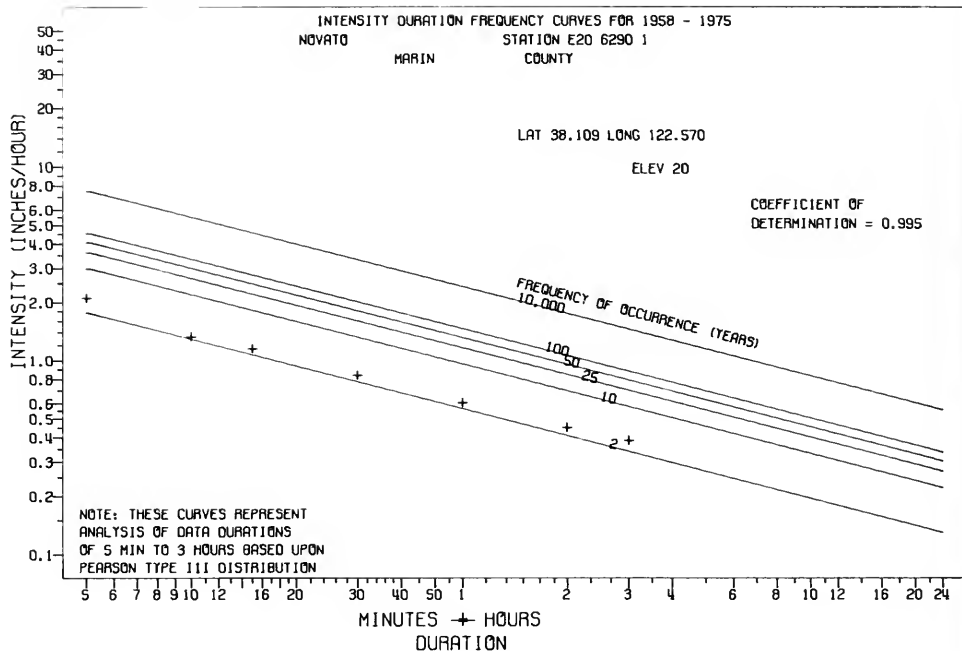


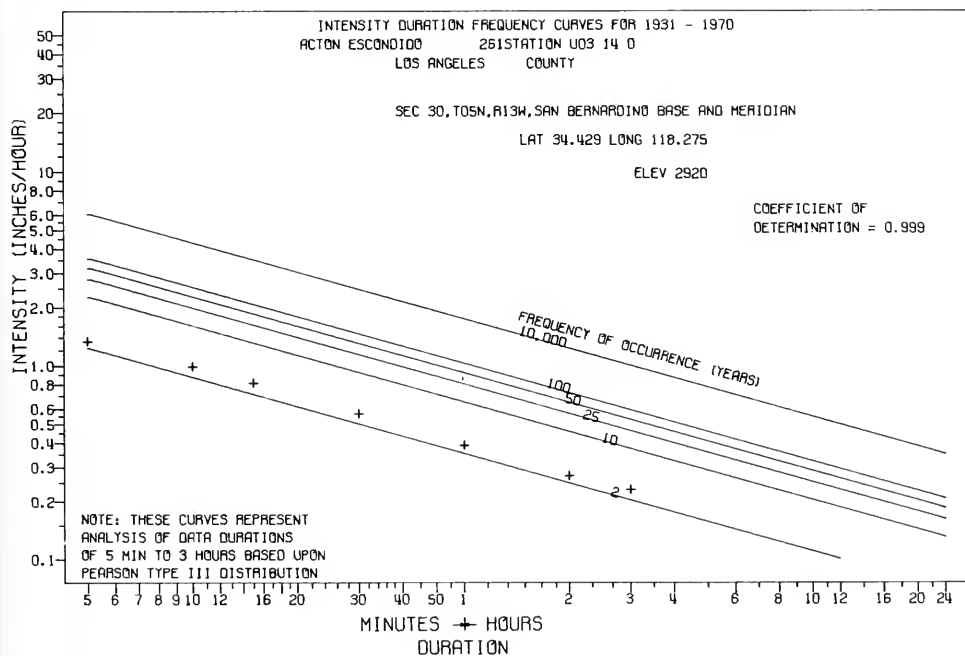
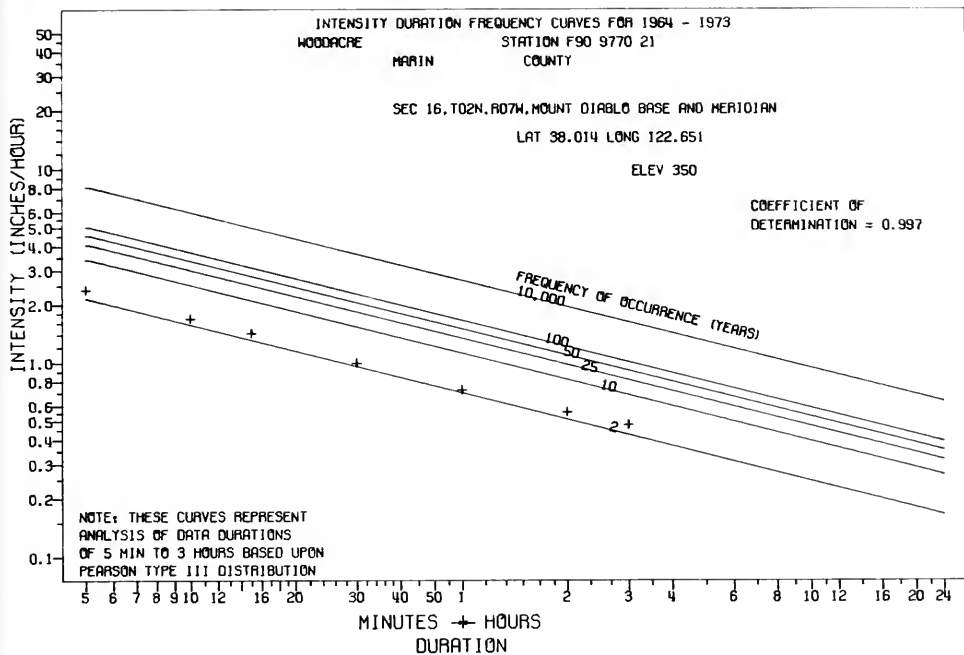


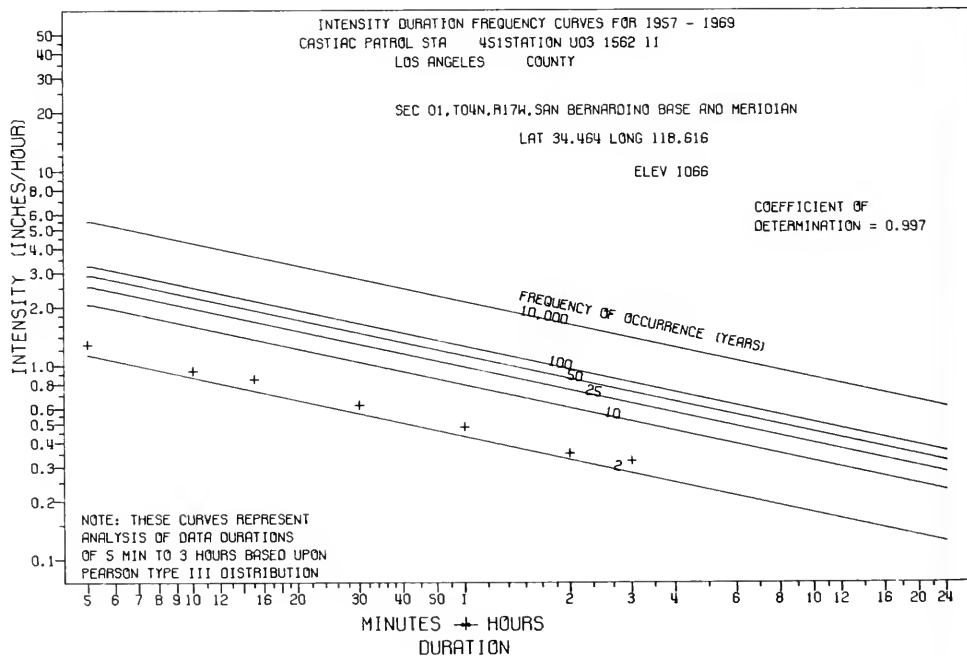
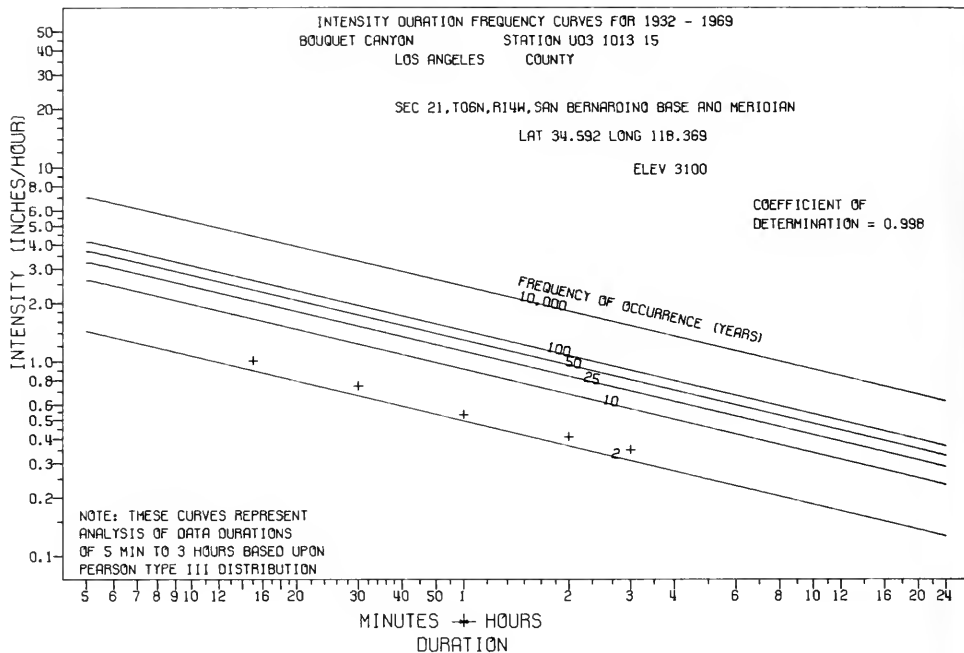












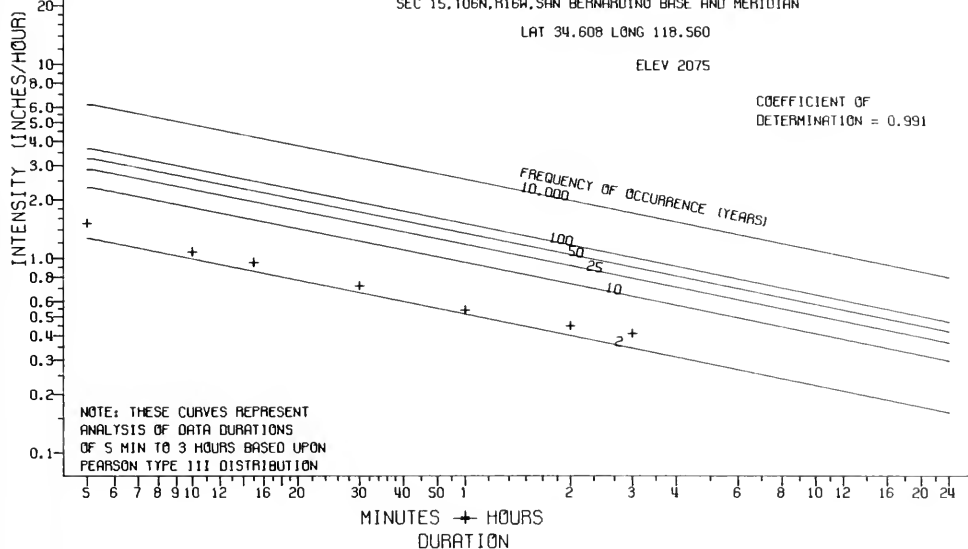
INTENSITY DURATION FREQUENCY CURVES FOR 1956 - 1971
ELIZABETH LAKE 128 STATION U03 2735 0
LOS ANGELES COUNTY

SEC 15, T06N, R16W, SAN BERNARDINO BASE AND MERIDIAN

LAT 34.608 LONG 118.560

ELEV 2075

COEFFICIENT OF
DETERMINATION = 0.991

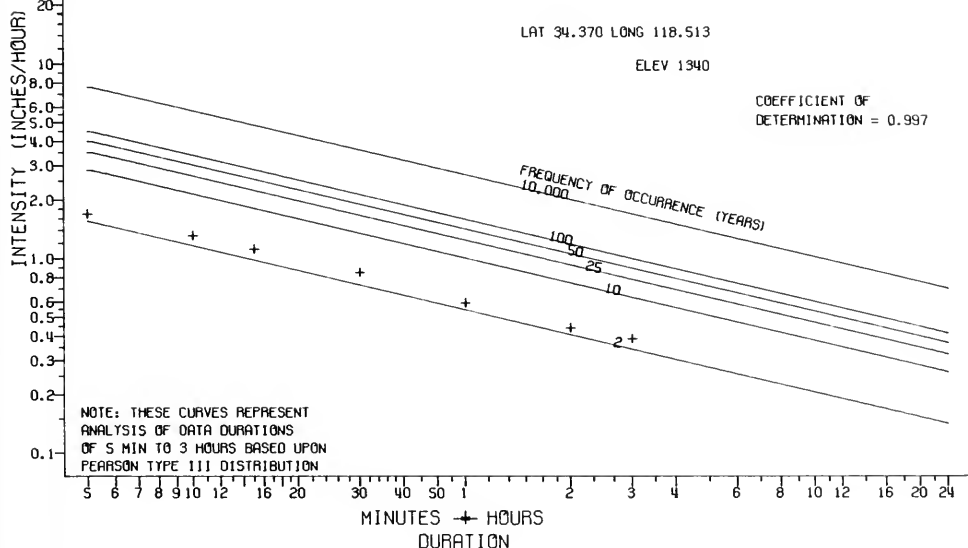


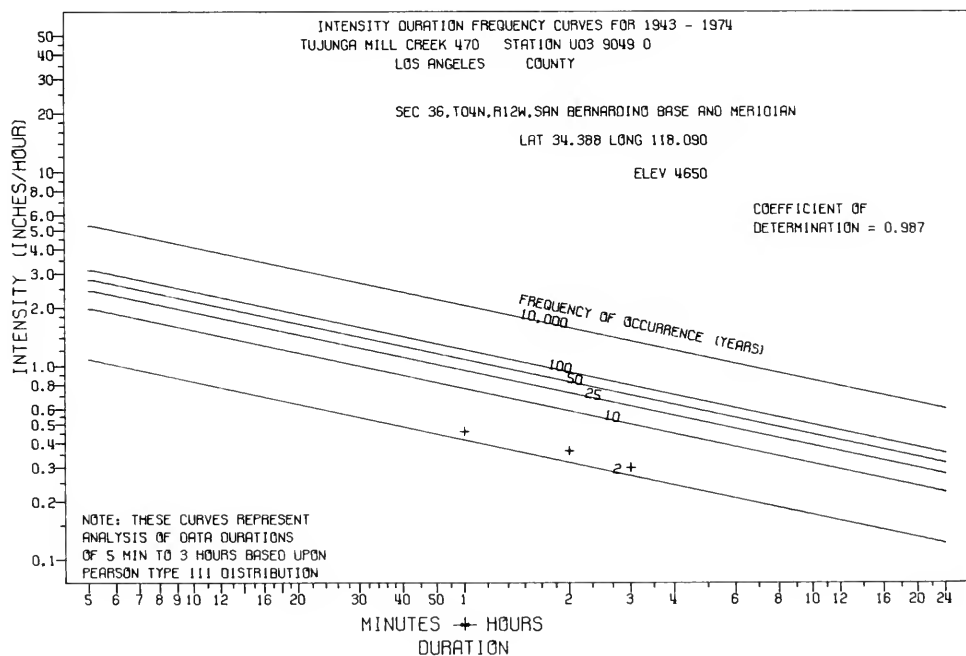
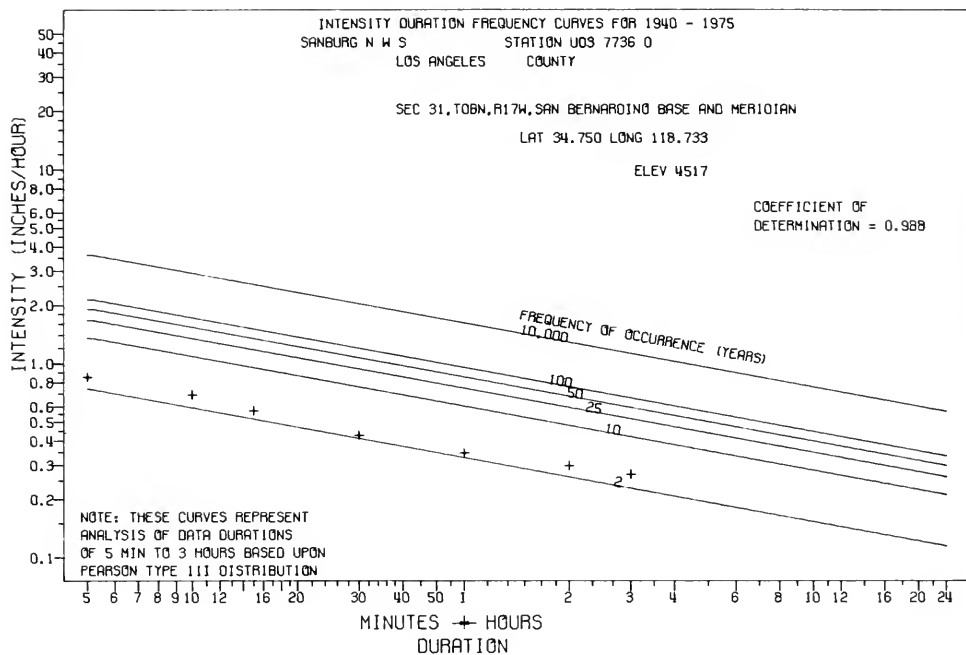
INTENSITY DURATION FREQUENCY CURVES FOR 1940 - 1974
NEWMALL RANGER STATION STATION U03 6164 0
LOS ANGELES COUNTY

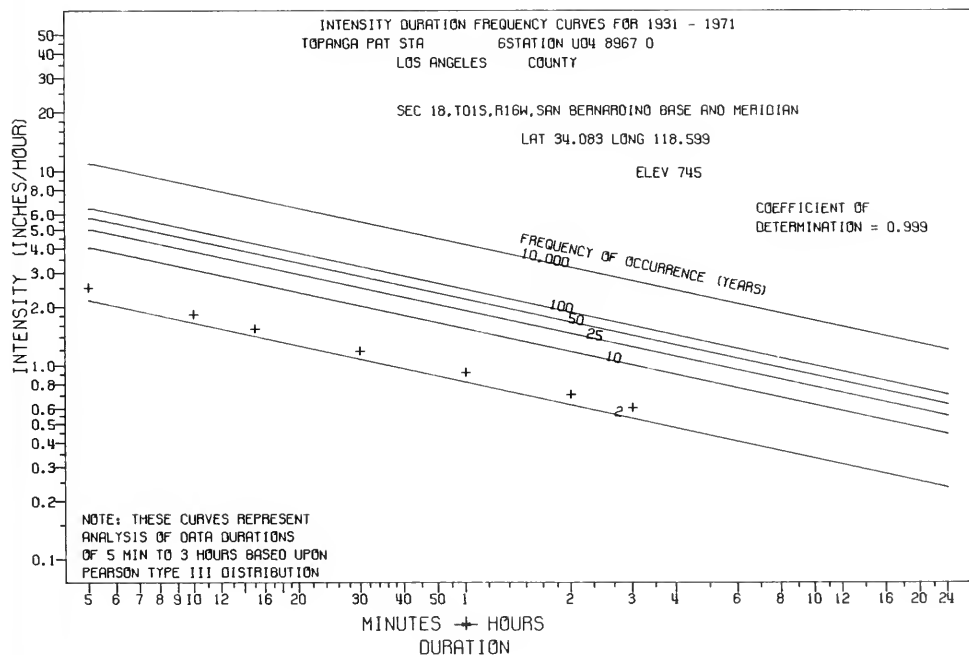
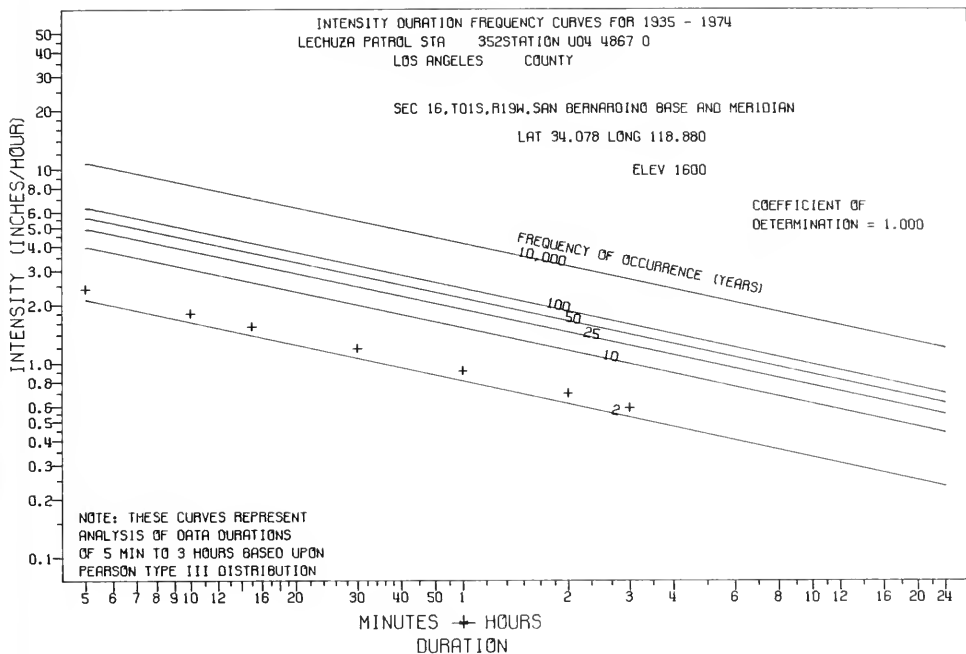
LAT 34.370 LONG 118.513

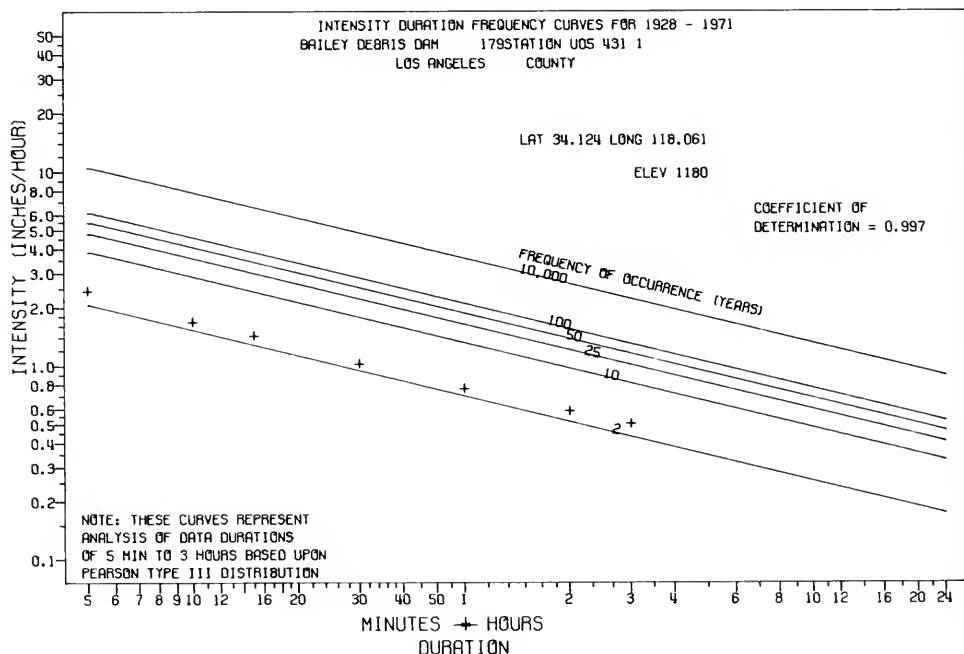
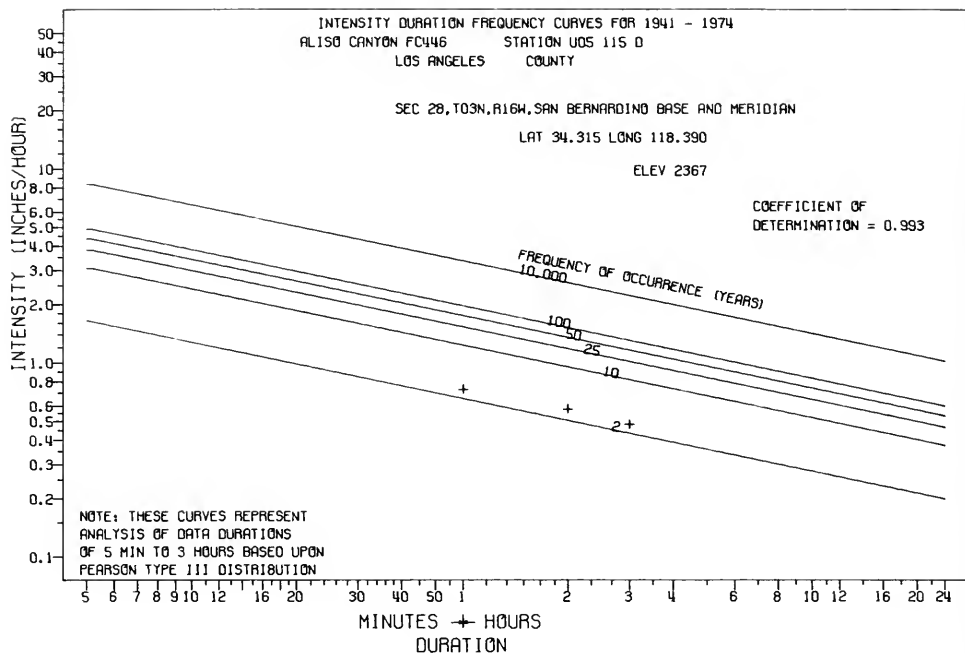
ELEV 1340

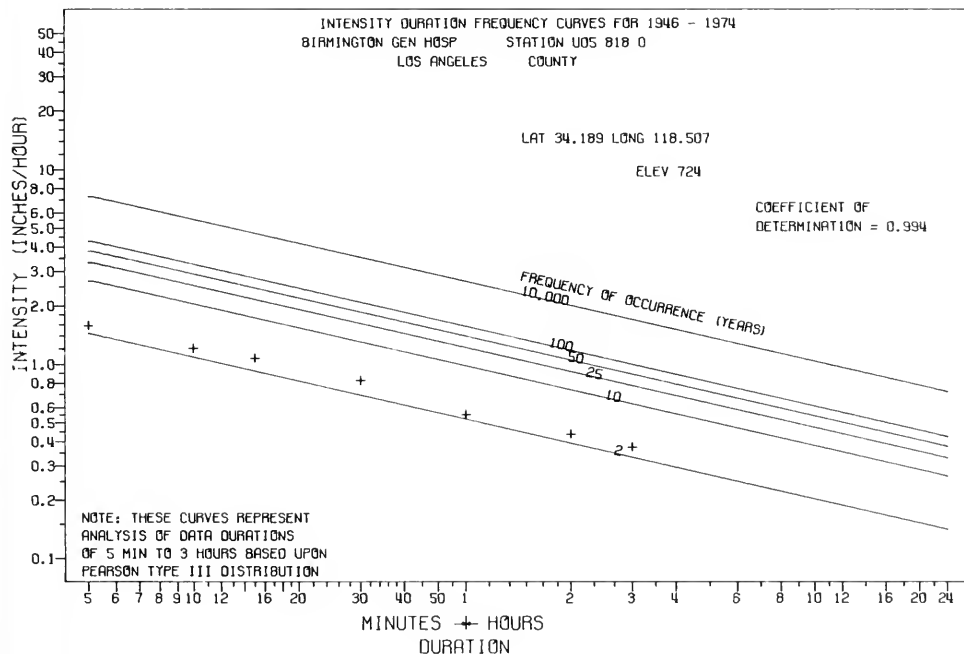
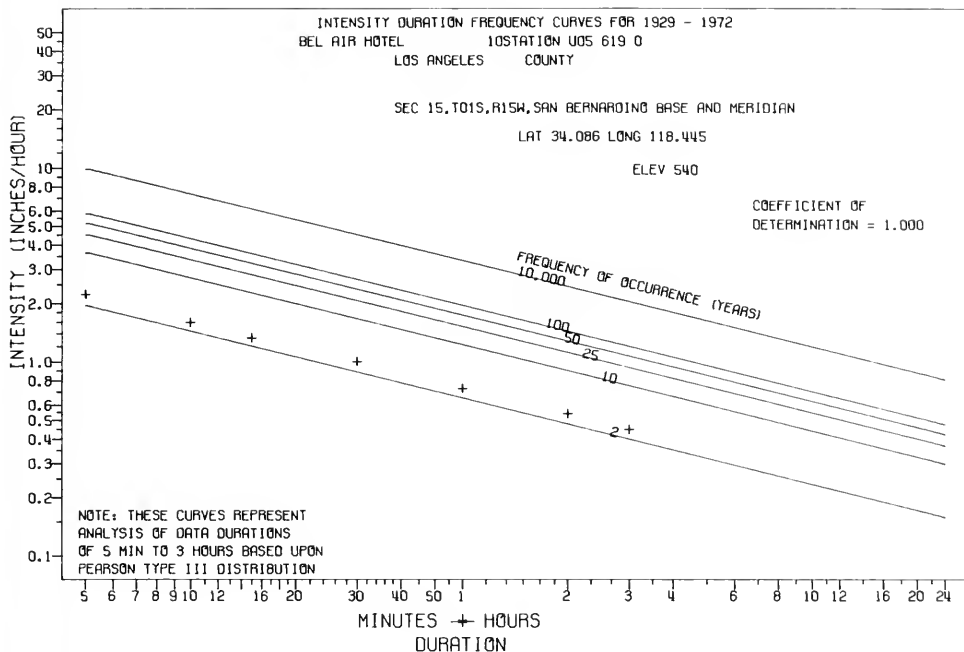
COEFFICIENT OF
DETERMINATION = 0.997

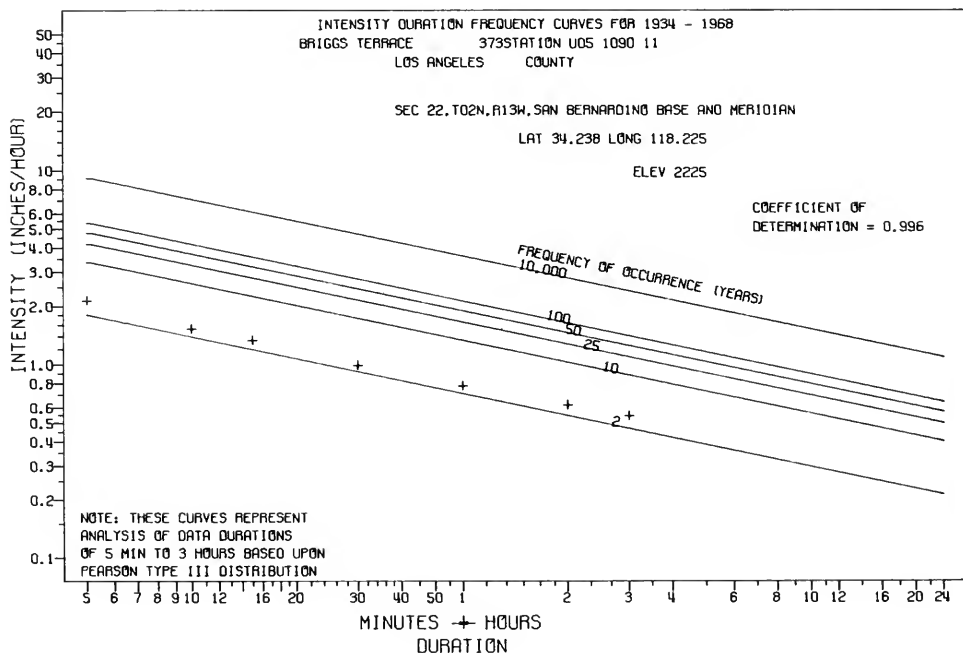
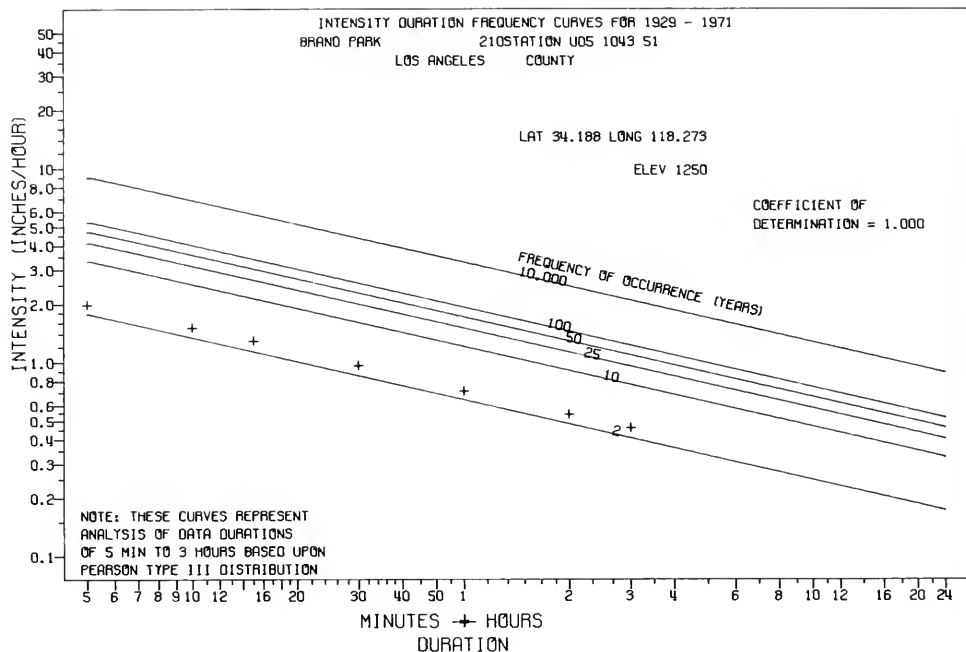












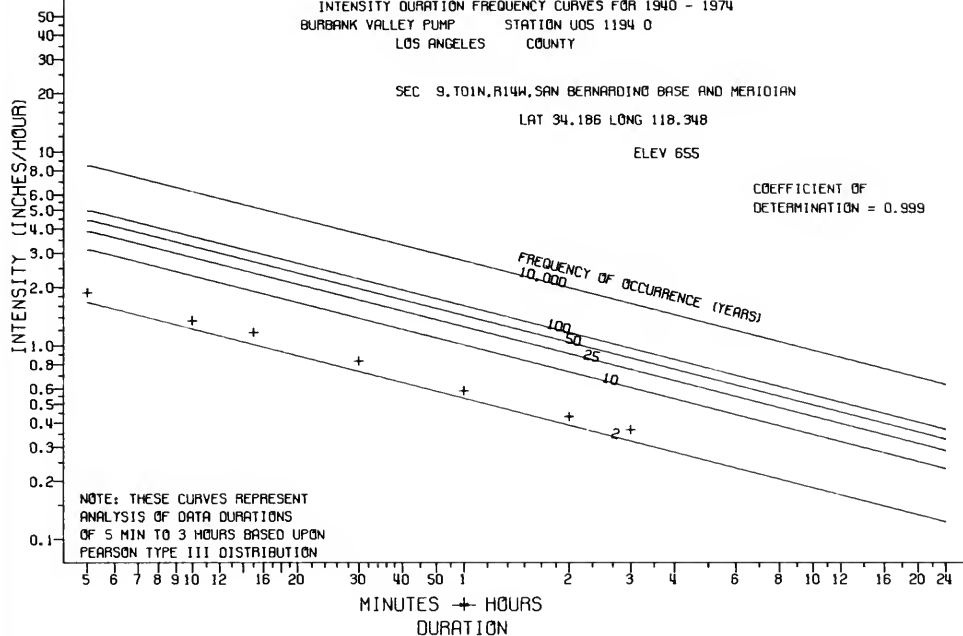
INTENSITY DURATION FREQUENCY CURVES FOR 1940 - 1974
BURBANK VALLEY PUMP STATION UDS 1194 0
LOS ANGELES COUNTY

SEC 9, T01N, R14W, SAN BERNARDINO BASE AND MERIDIAN

LAT 34.186 LONG 118.348

ELEV 655

COEFFICIENT OF
DETERMINATION = 0.999



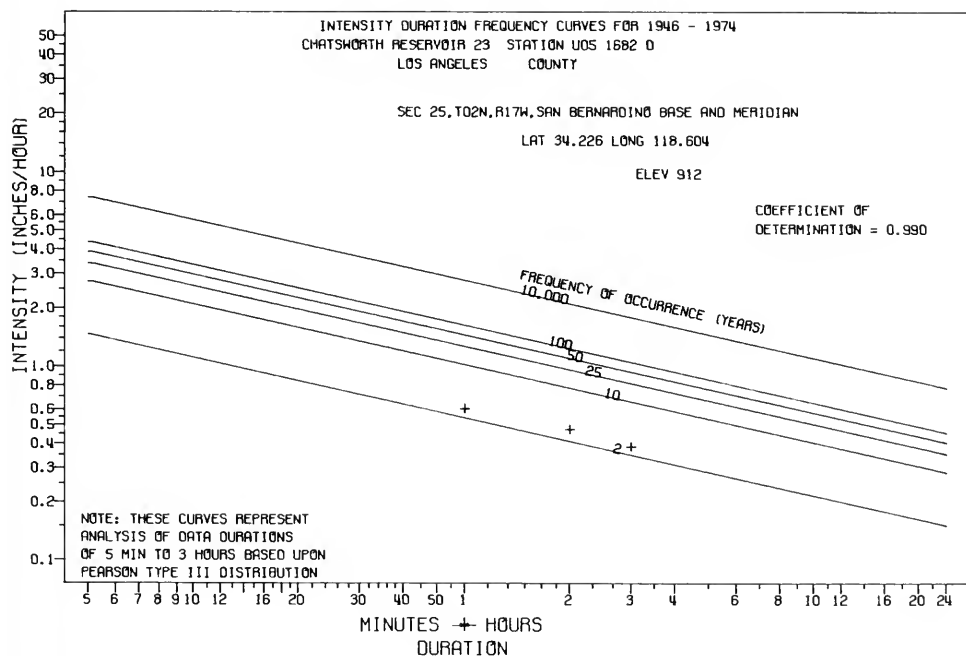
INTENSITY DURATION FREQUENCY CURVES FOR 1946 - 1974
CHATSWORTH RESERVOIR 23 STATION UDS 1682 0
LOS ANGELES COUNTY

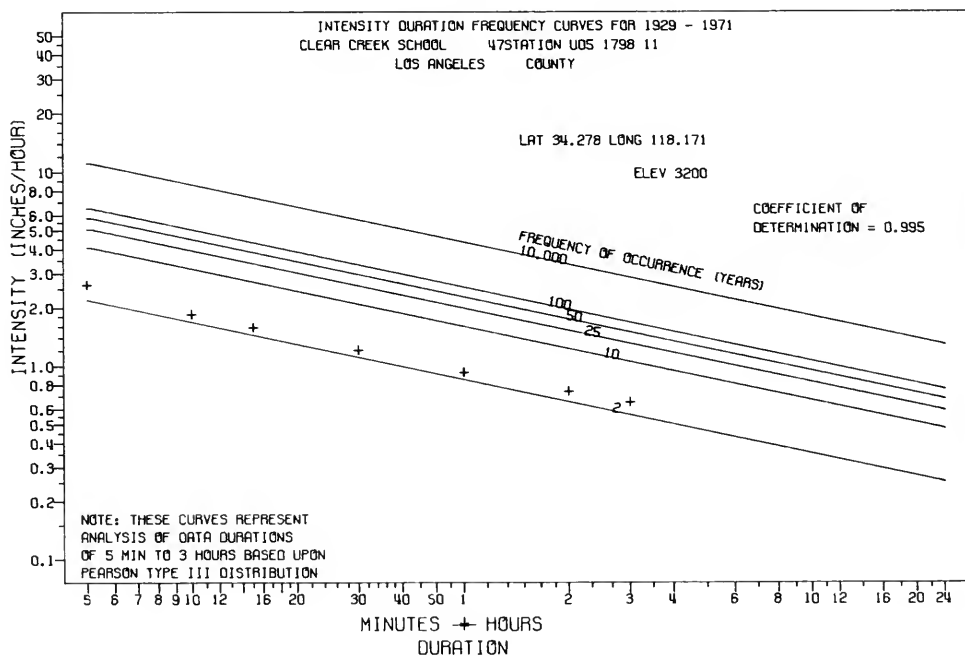
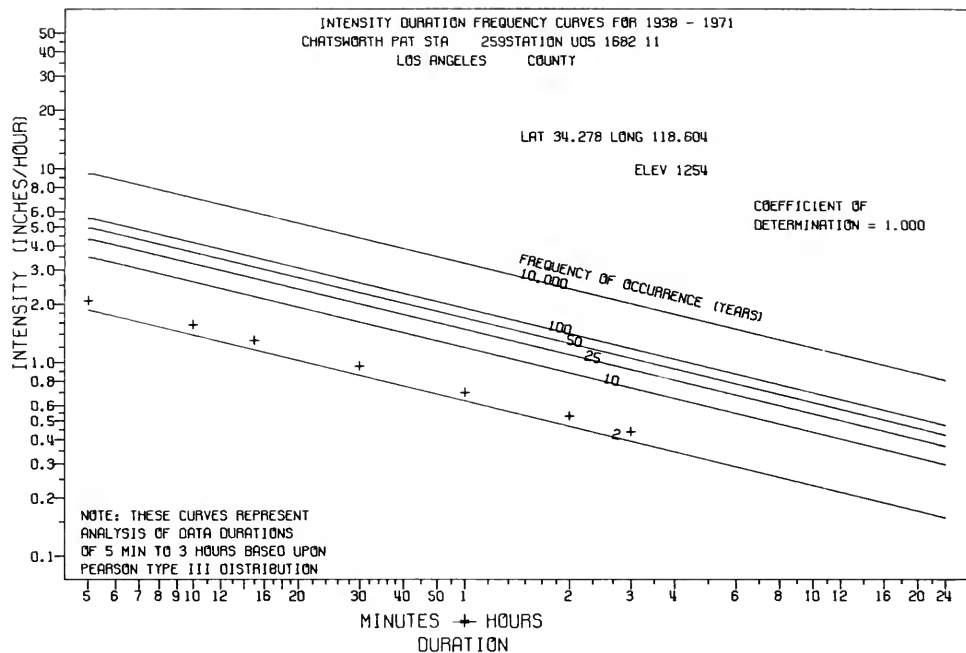
SEC 25, T02N, R17W, SAN BERNARDINO BASE AND MERIDIAN

LAT 34.226 LONG 118.604

ELEV 912

COEFFICIENT OF
DETERMINATION = 0.990





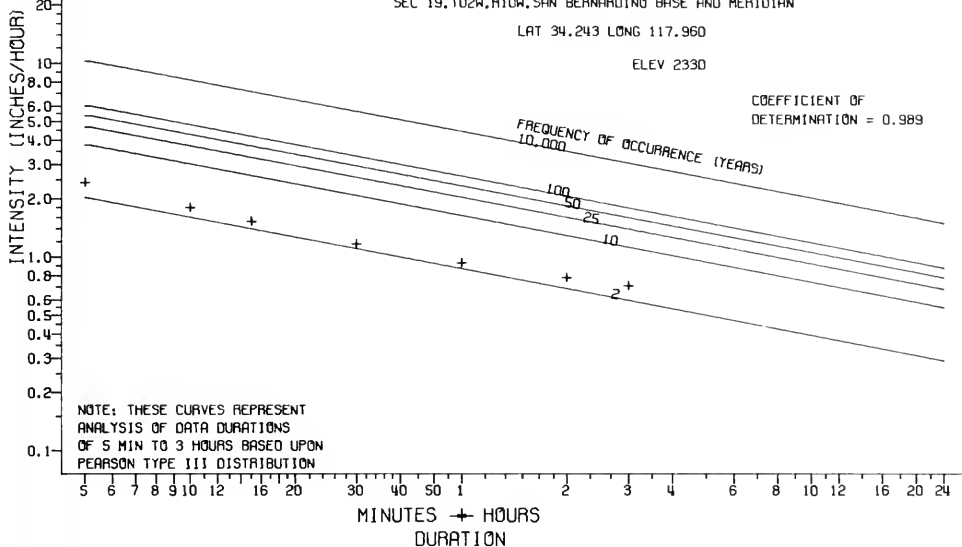
INTENSITY DURATION FREQUENCY CURVES FOR 1933 - 1968
 COGSWELL DAM 334 STATION UDS 1883 0
 LOS ANGELES COUNTY

SEC 19, T02W, R10W, SAN BERNARDINO BASE AND MERIDIAN

LAT 34.243 LONG 117.960

ELEV 2330

COEFFICIENT OF
 DETERMINATION = 0.989



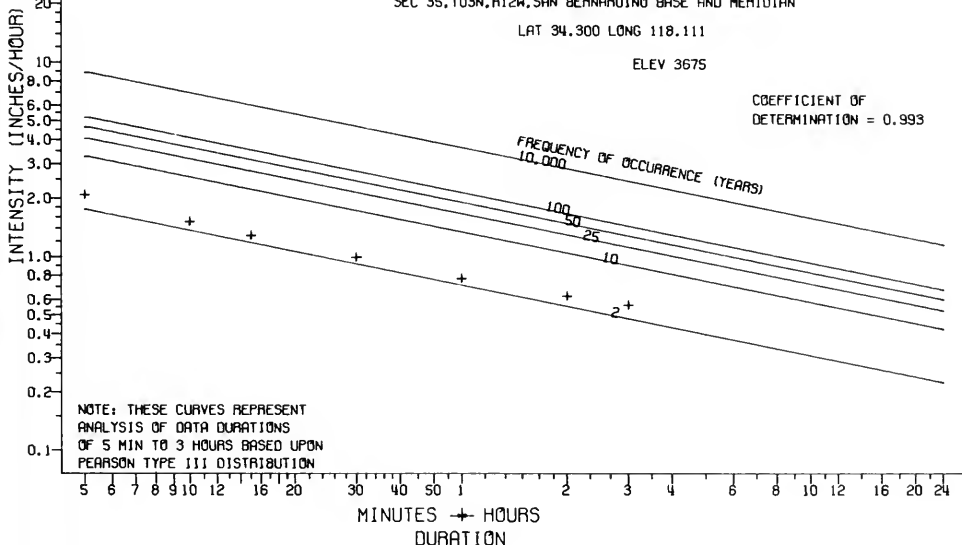
INTENSITY DURATION FREQUENCY CURVES FOR 1927 - 1971
 COLBY 53 STATION UDS 1896 0
 LOS ANGELES COUNTY

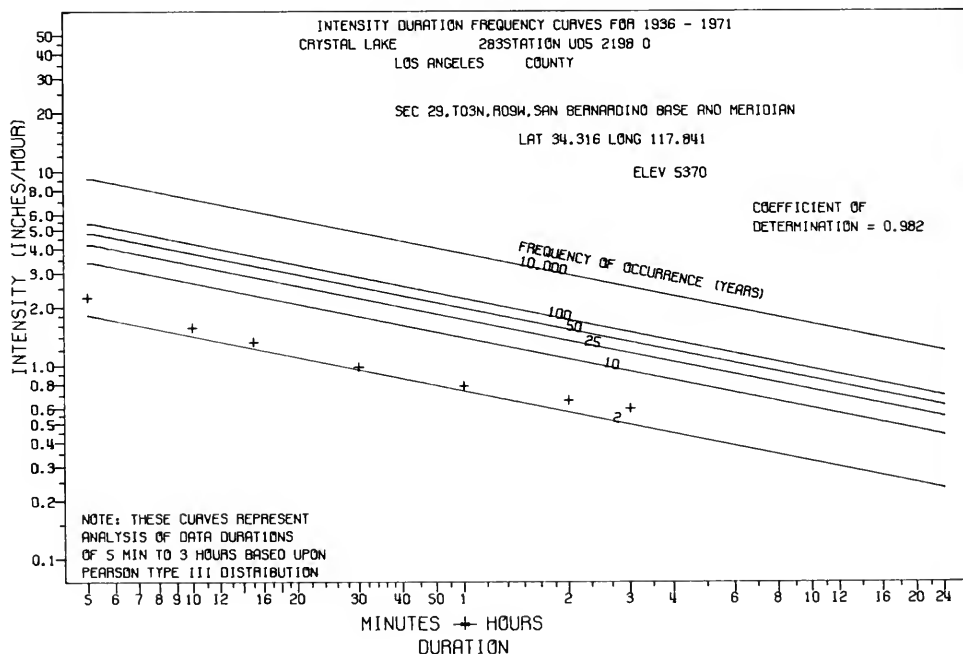
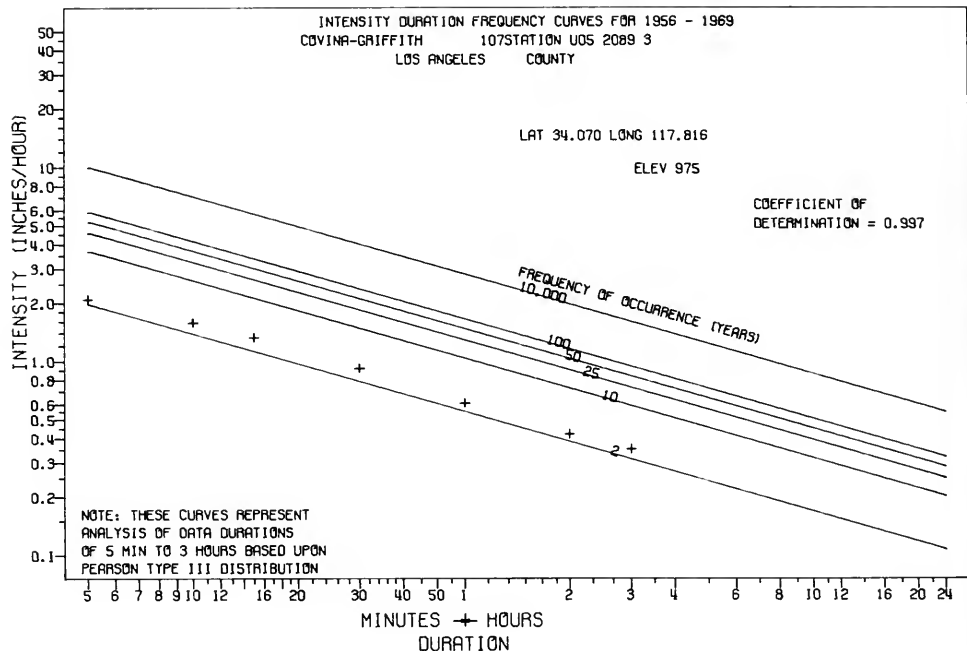
SEC 35, T03N, R12W, SAN BERNARDINO BASE AND MERIDIAN

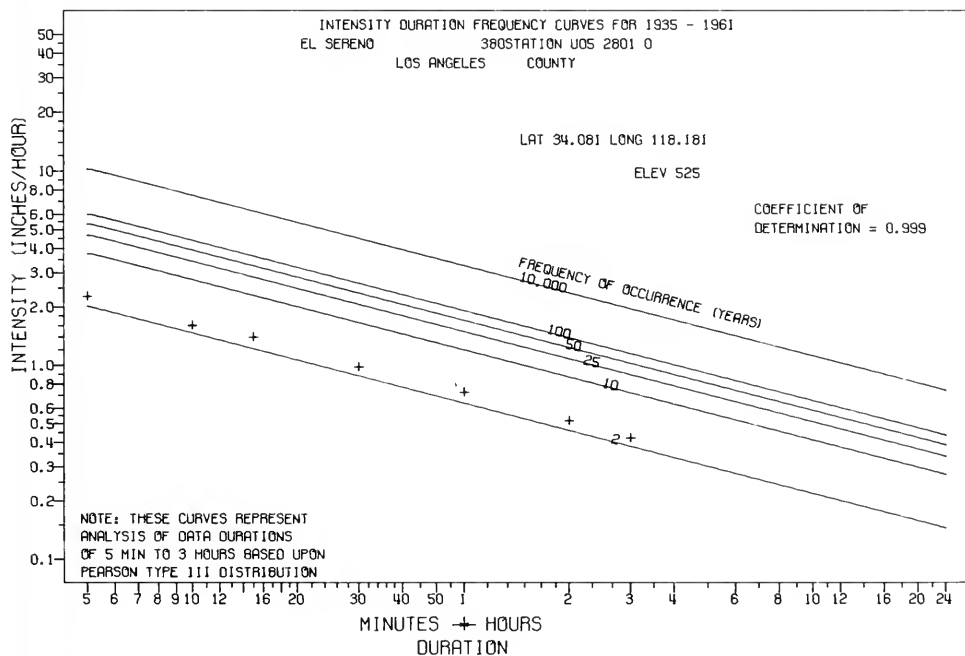
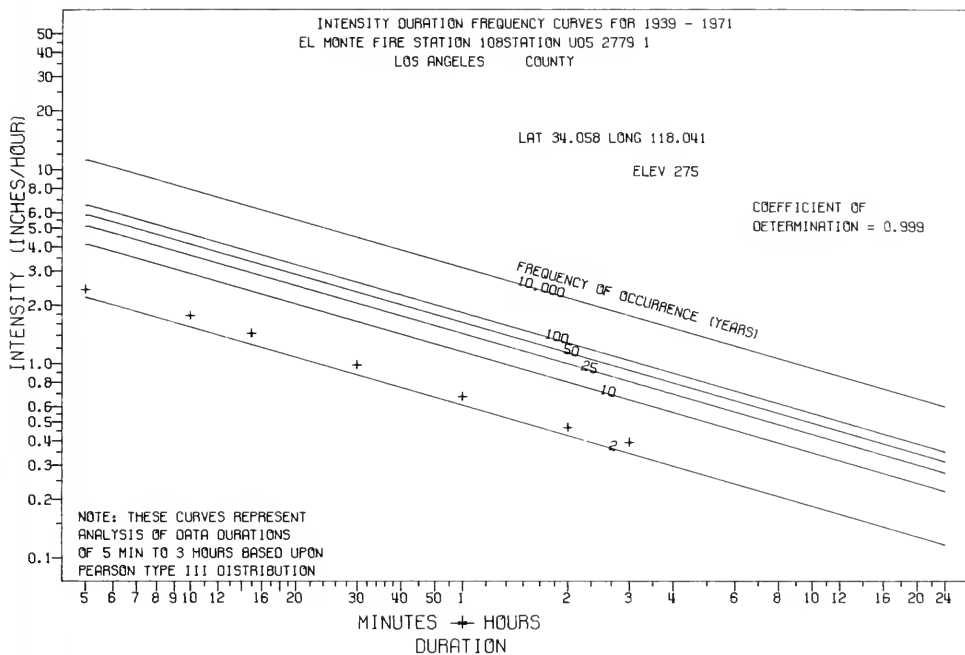
LAT 34.300 LONG 118.111

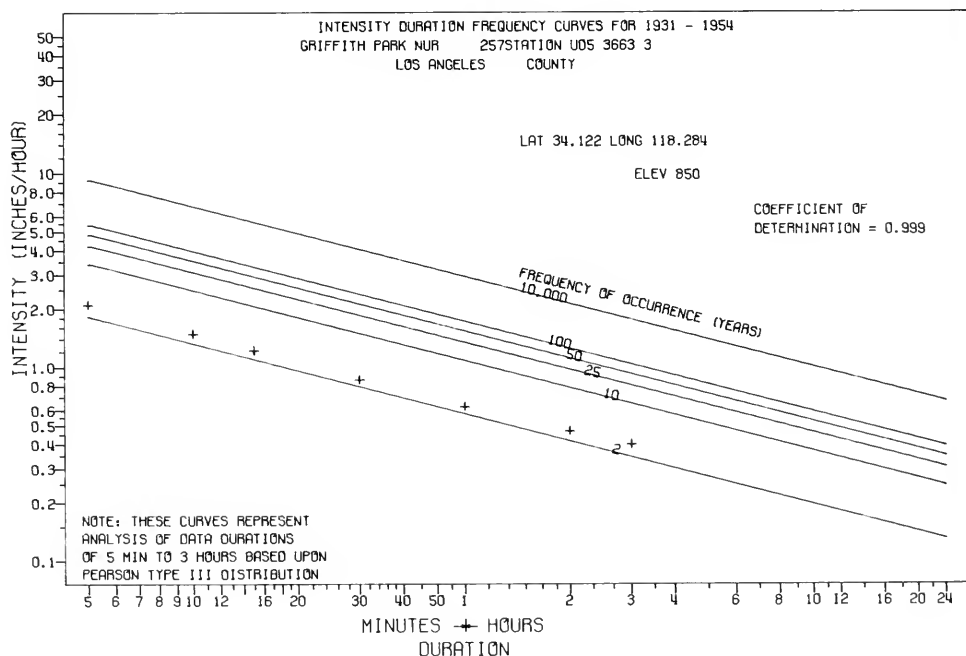
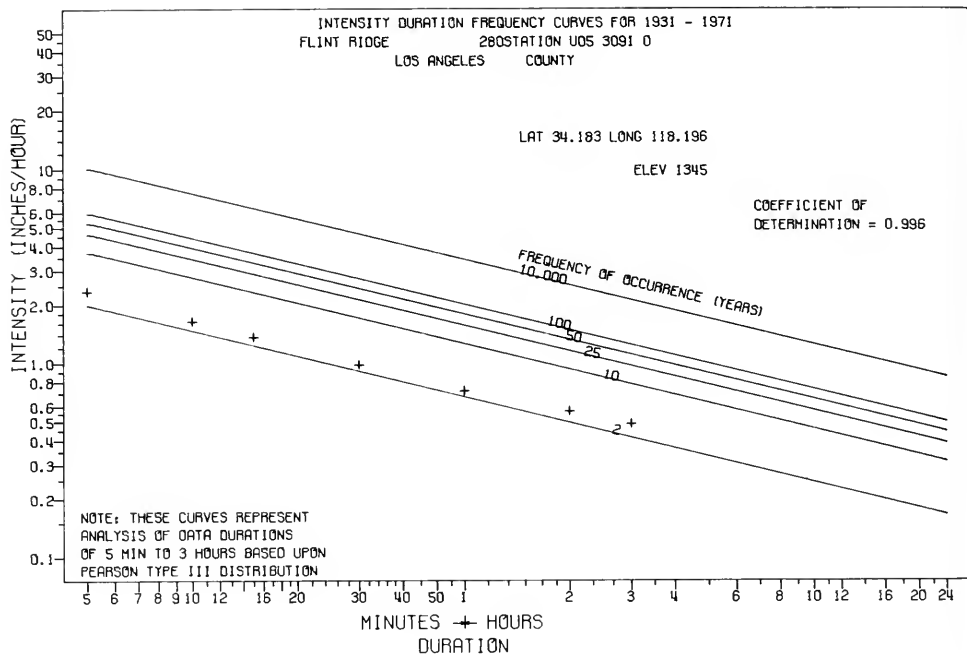
ELEV 3675

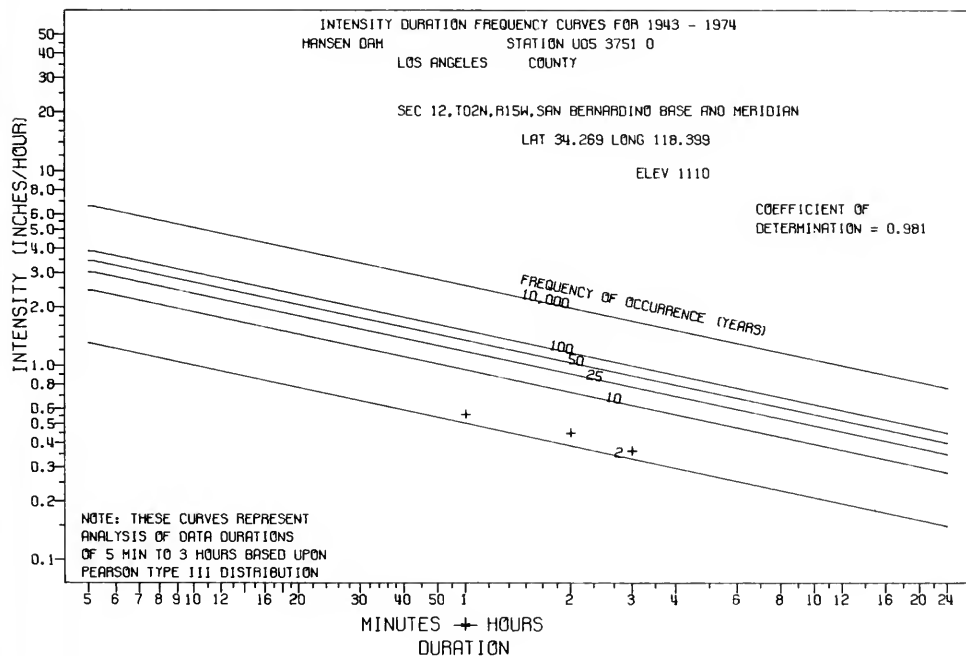
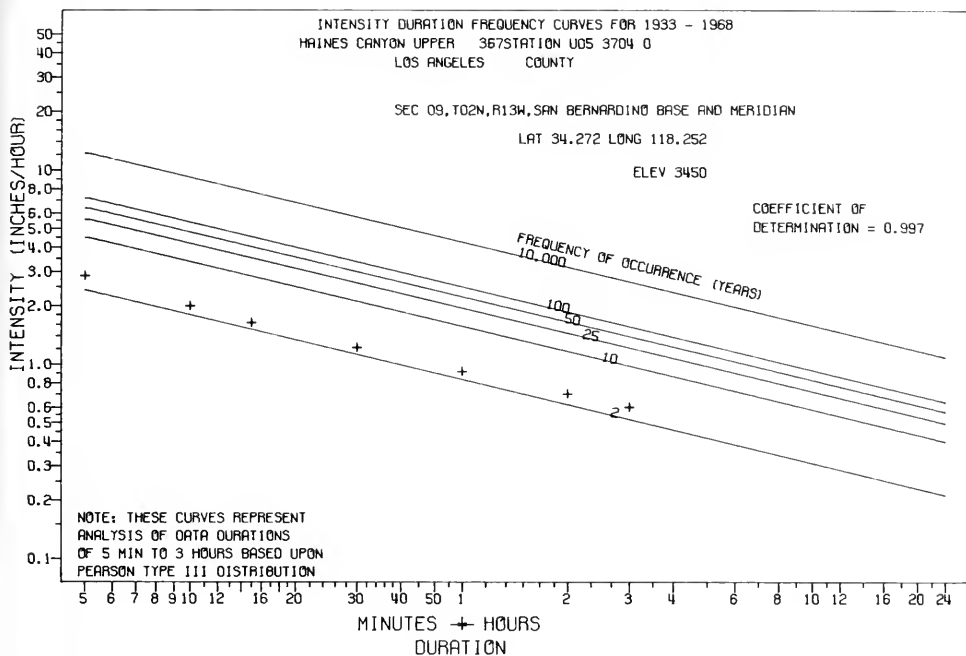
COEFFICIENT OF
 DETERMINATION = 0.993

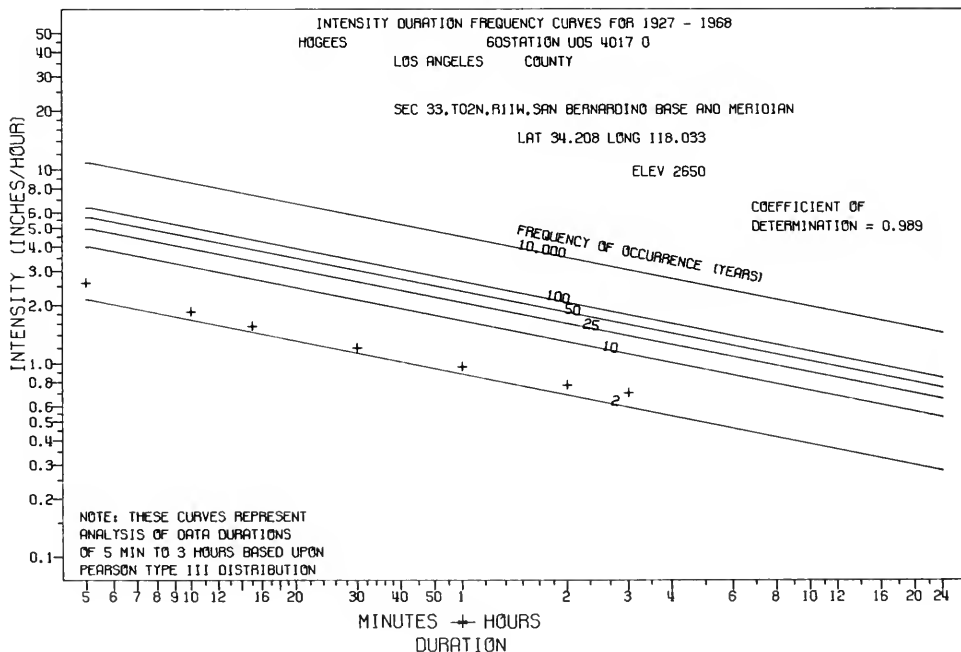
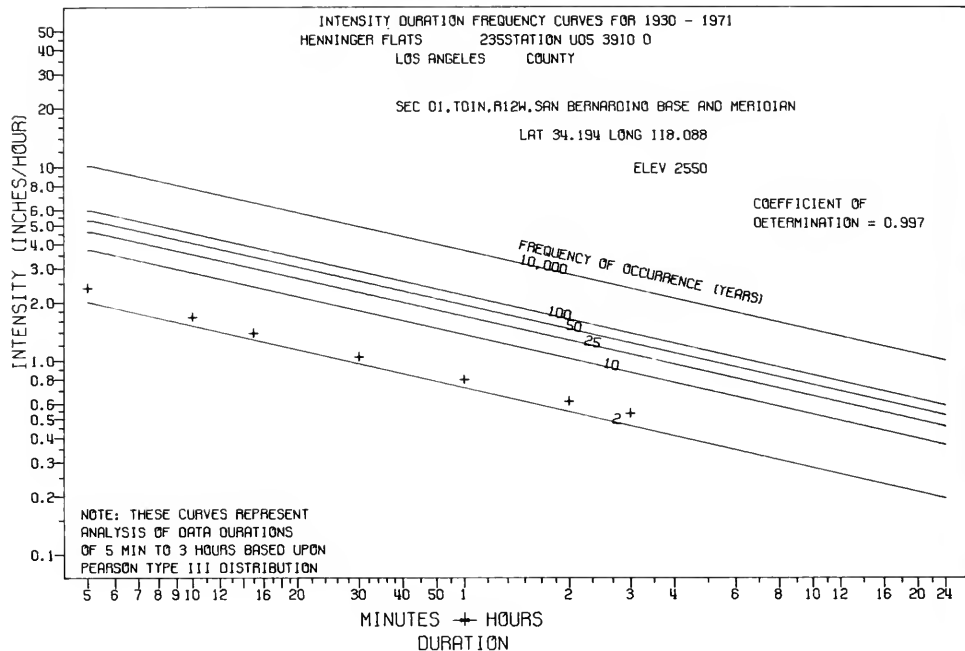


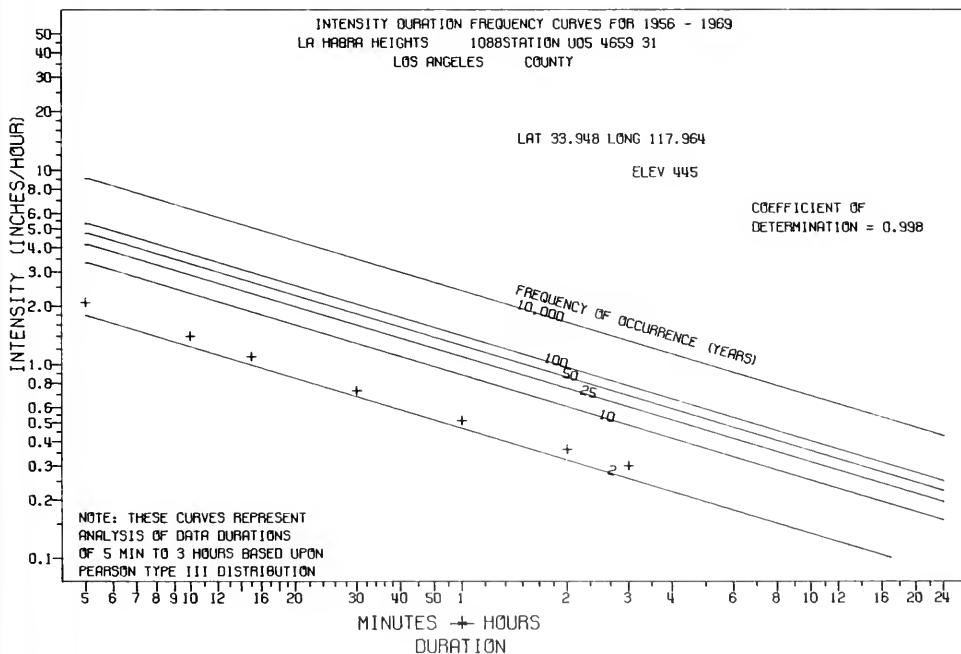
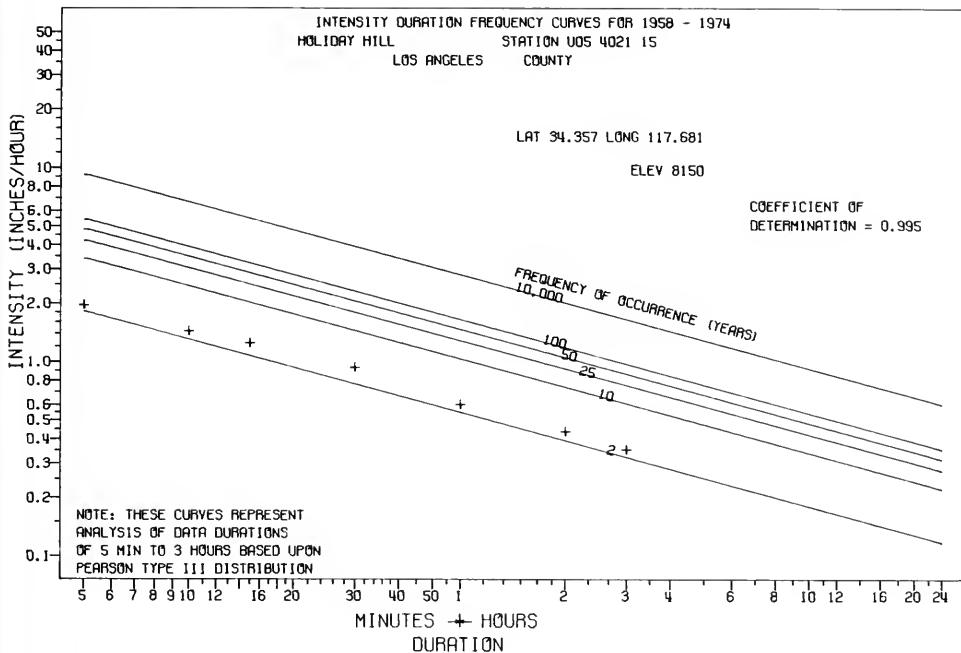


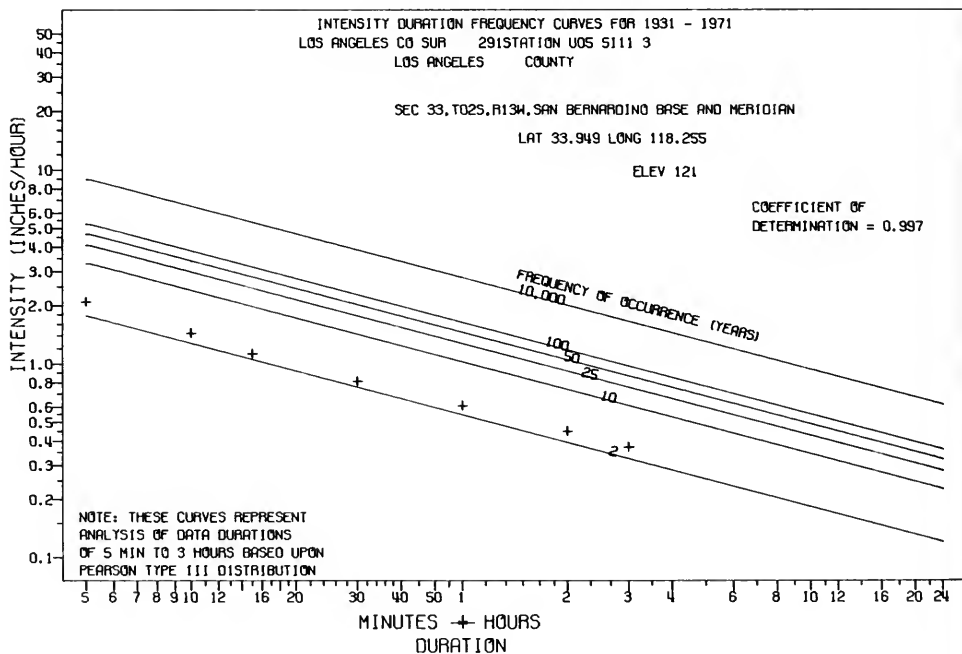
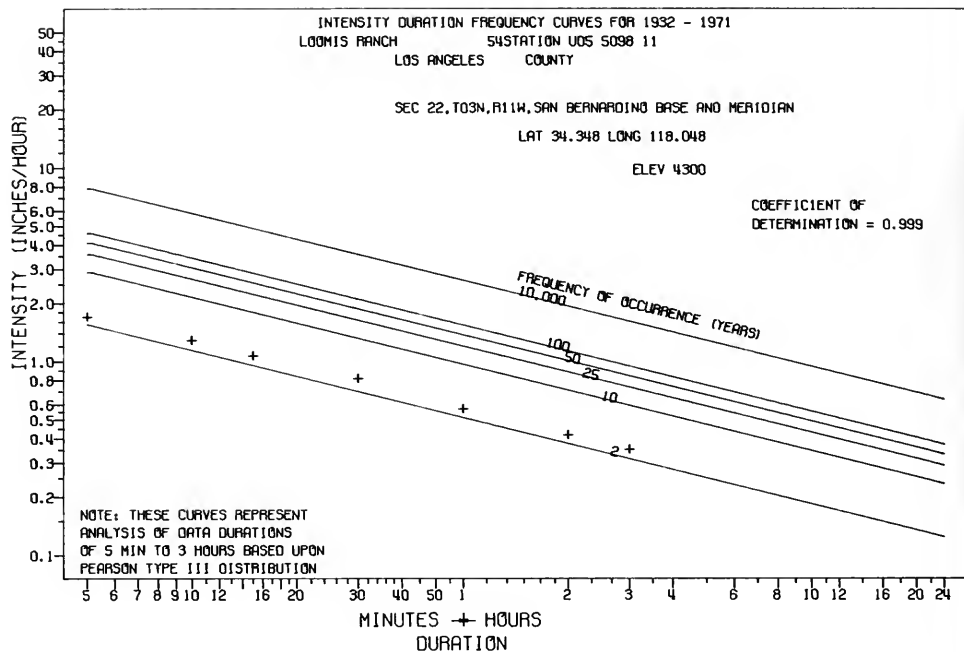


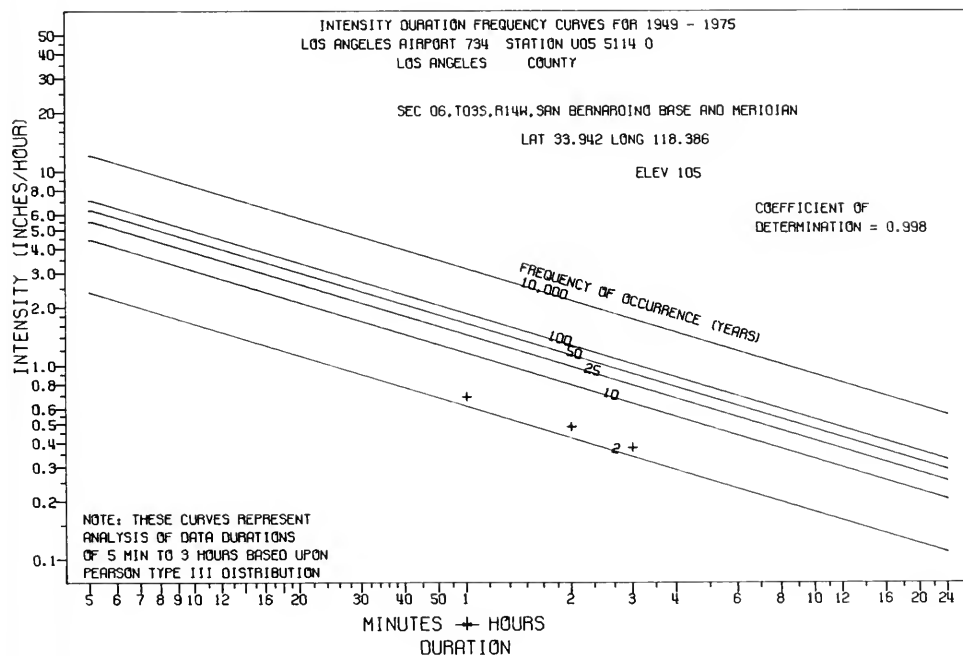
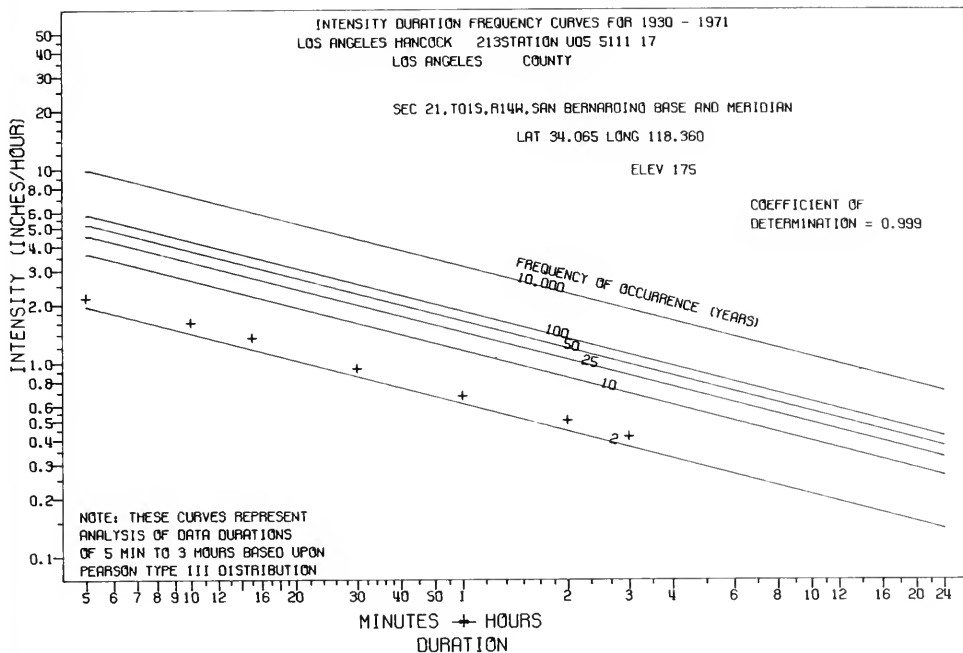


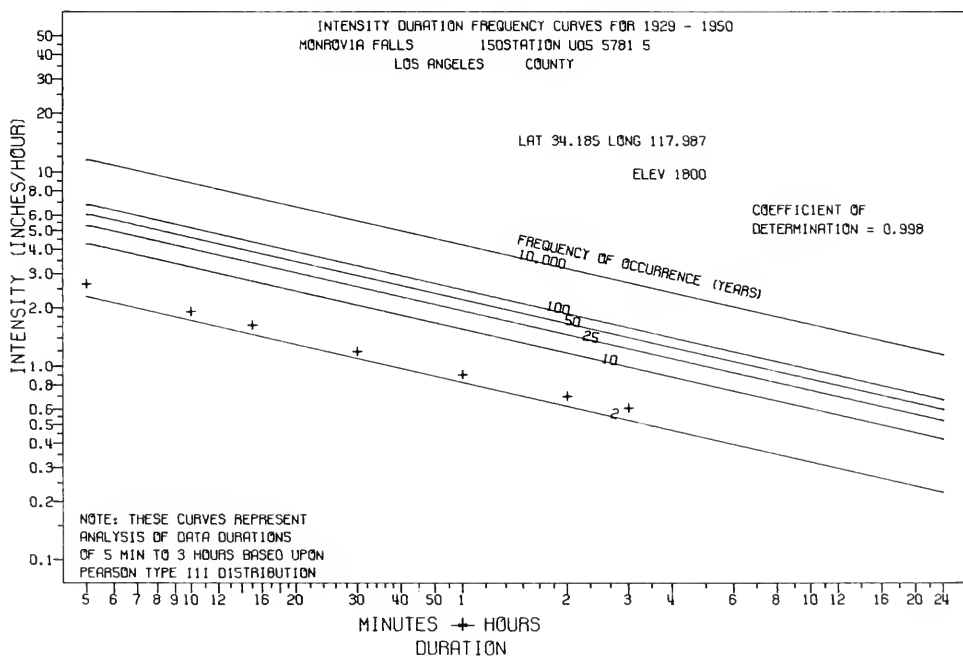
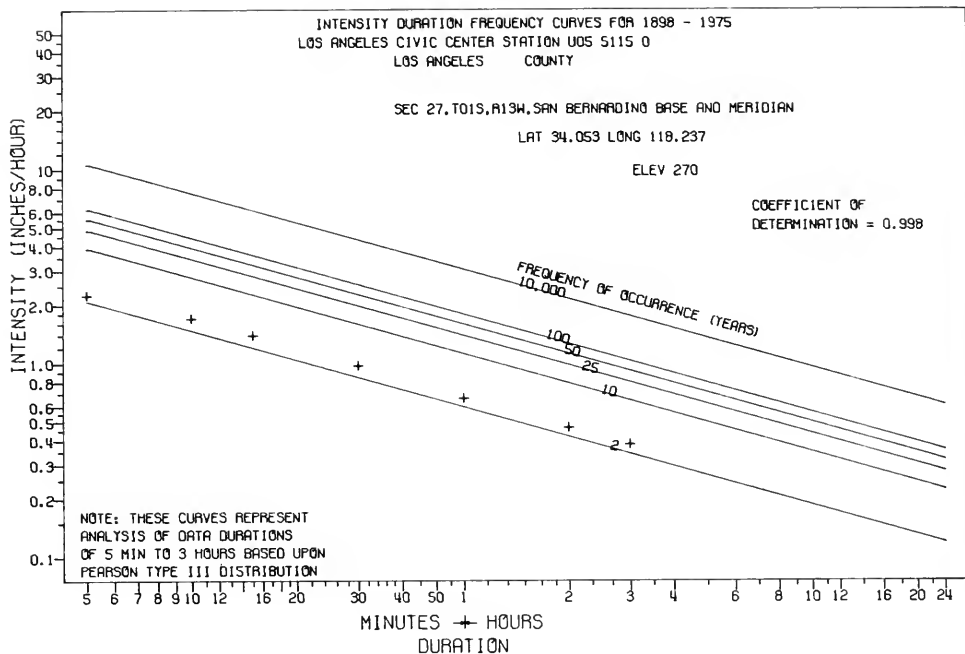


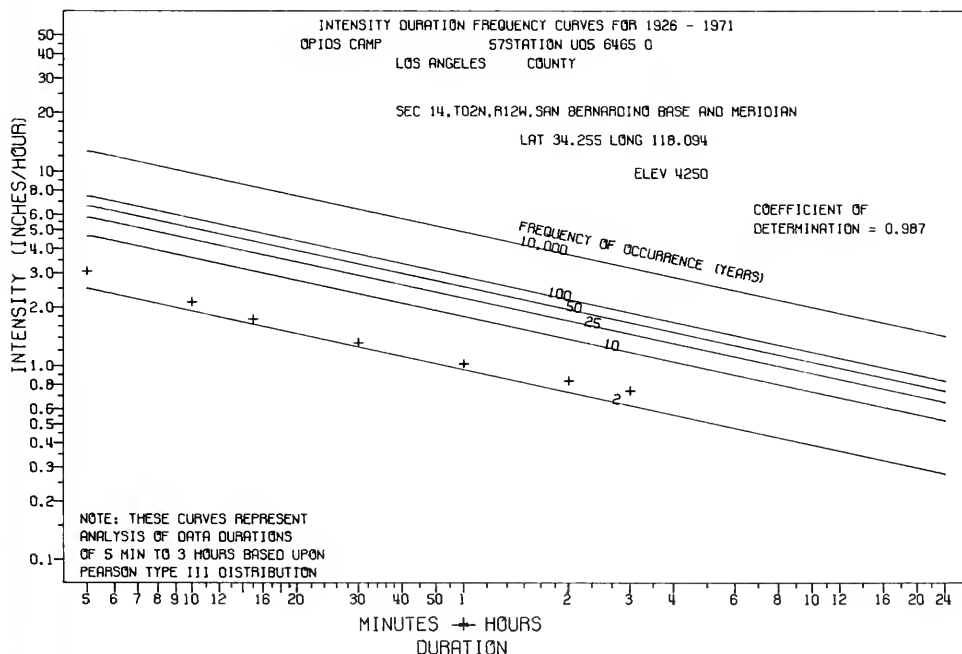
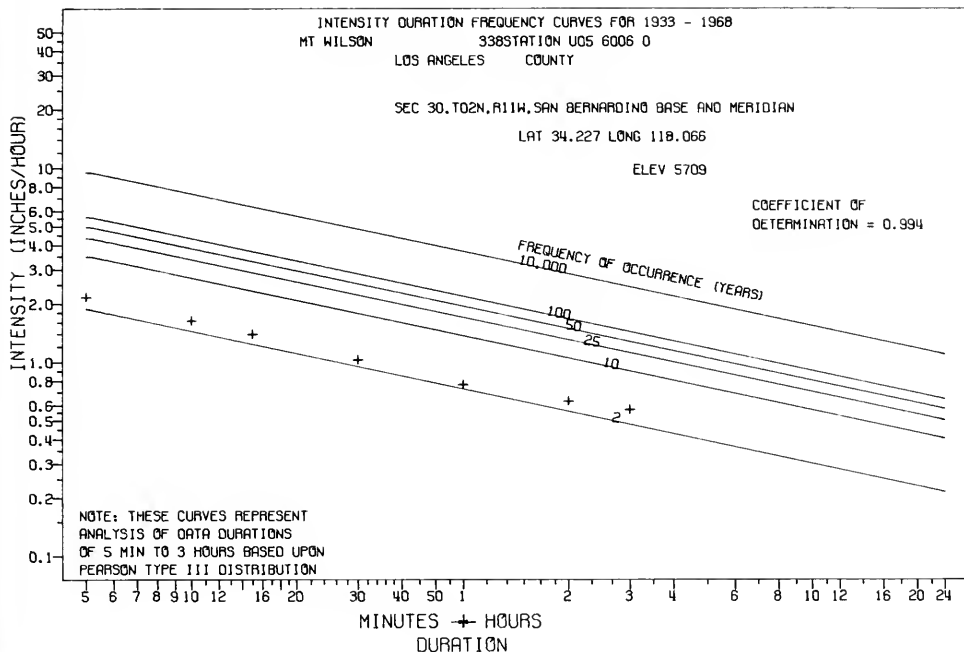


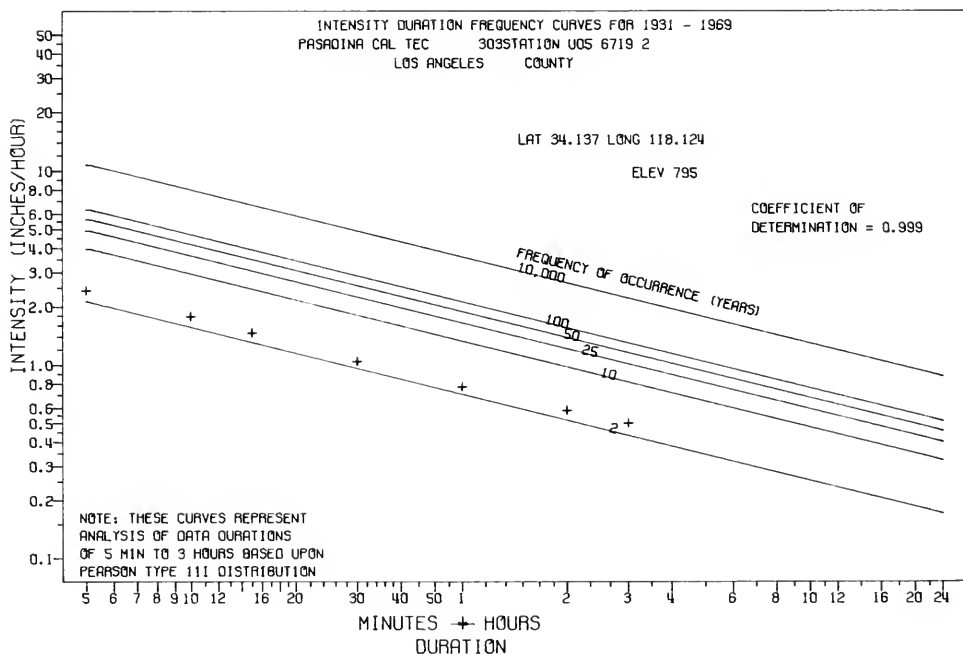
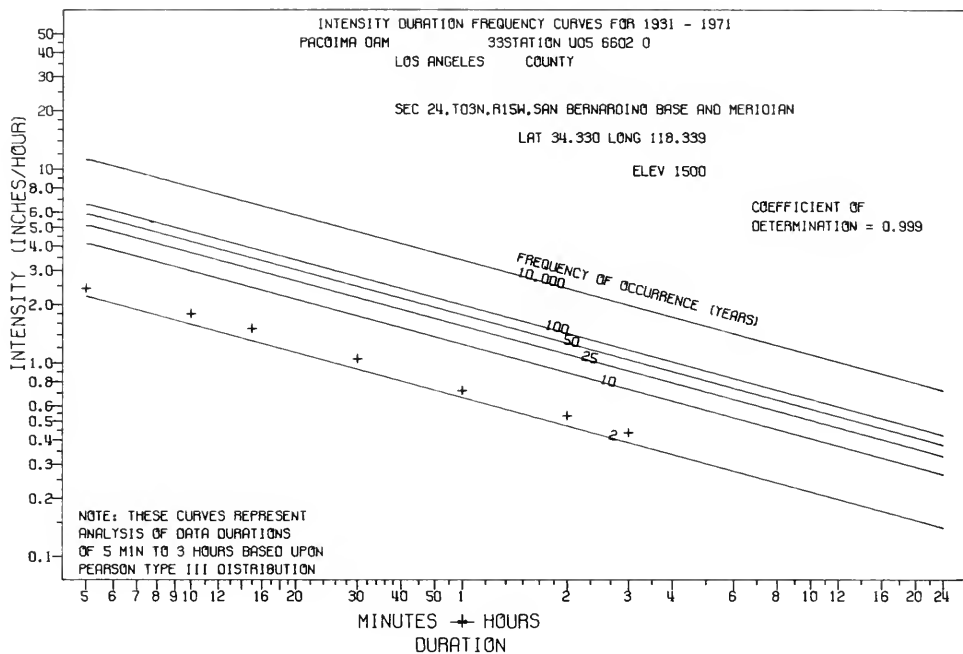












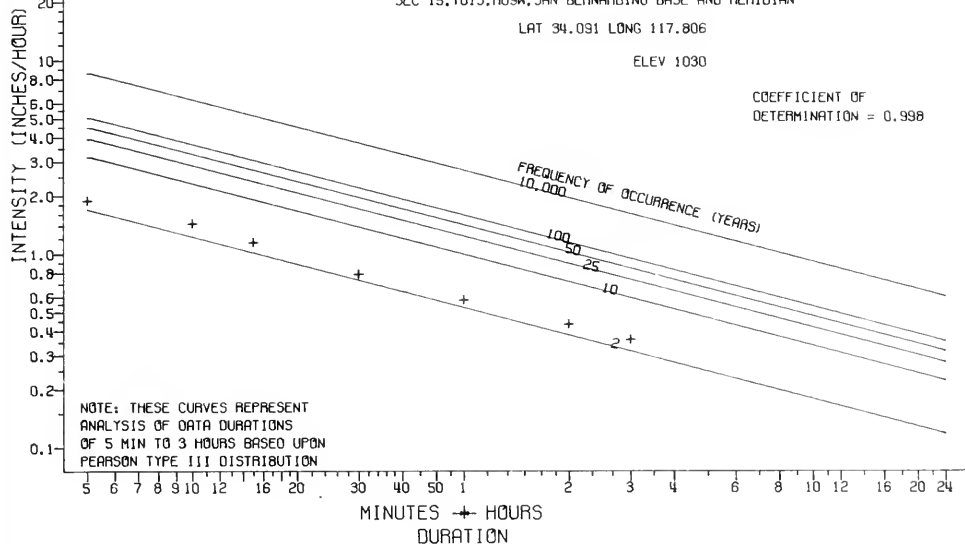
INTENSITY DURATION FREQUENCY CURVES FOR 1953 - 1971
PUDDINGSTONE DAM 96 STATION U05 7160 1
LOS ANGELES COUNTY

SEC 15, T01S, R03W, SAN BERNARDINO BASE AND MERIDIAN

LAT 34.031 LONG 117.806

ELEV 1030

COEFFICIENT OF
DETERMINATION = 0.998

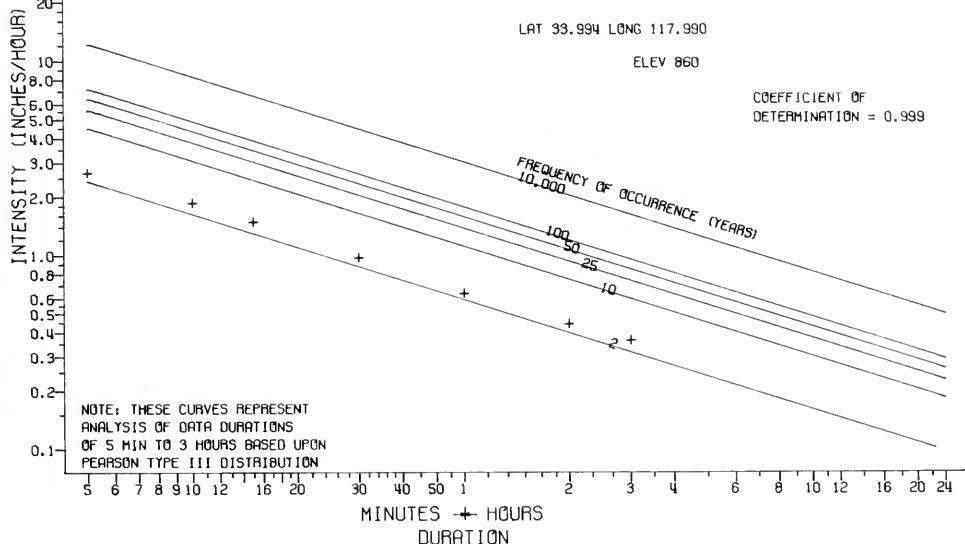


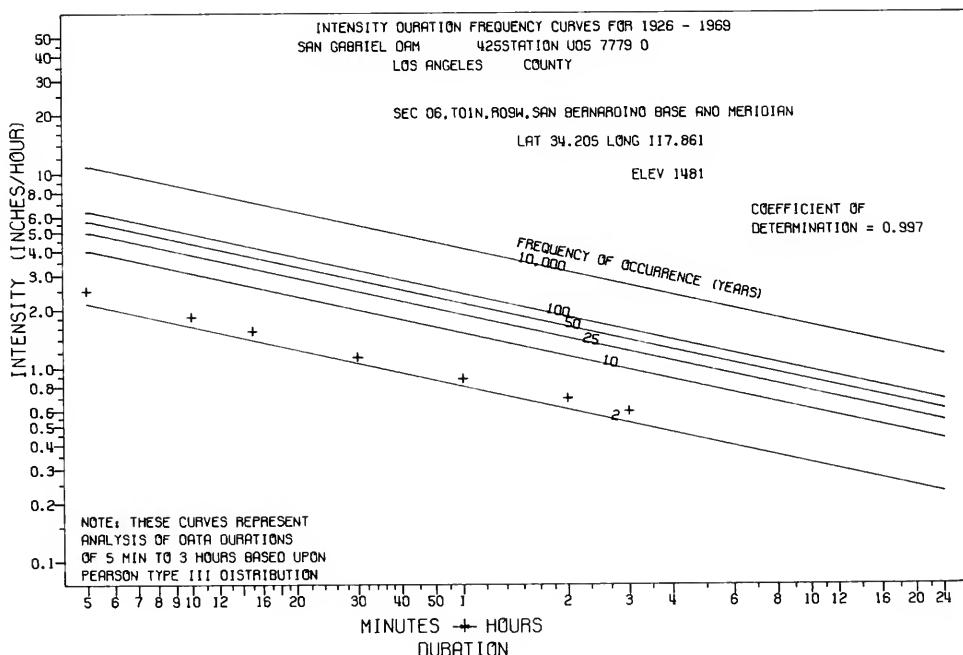
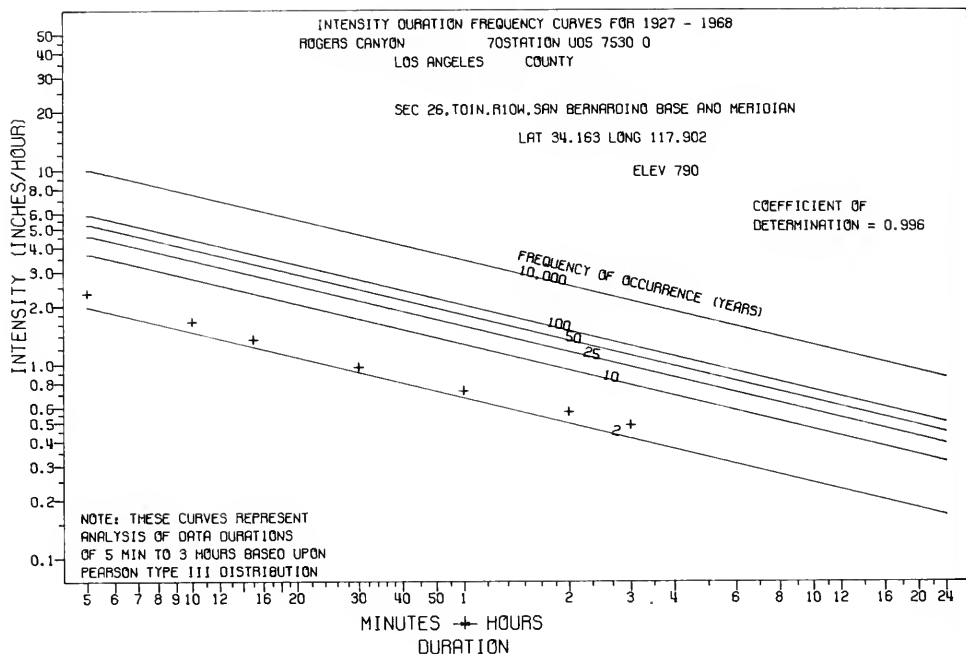
INTENSITY DURATION FREQUENCY CURVES FOR 1941 - 1972
PUENTE HILLS 201 STATION U05 7161 6
LOS ANGELES COUNTY

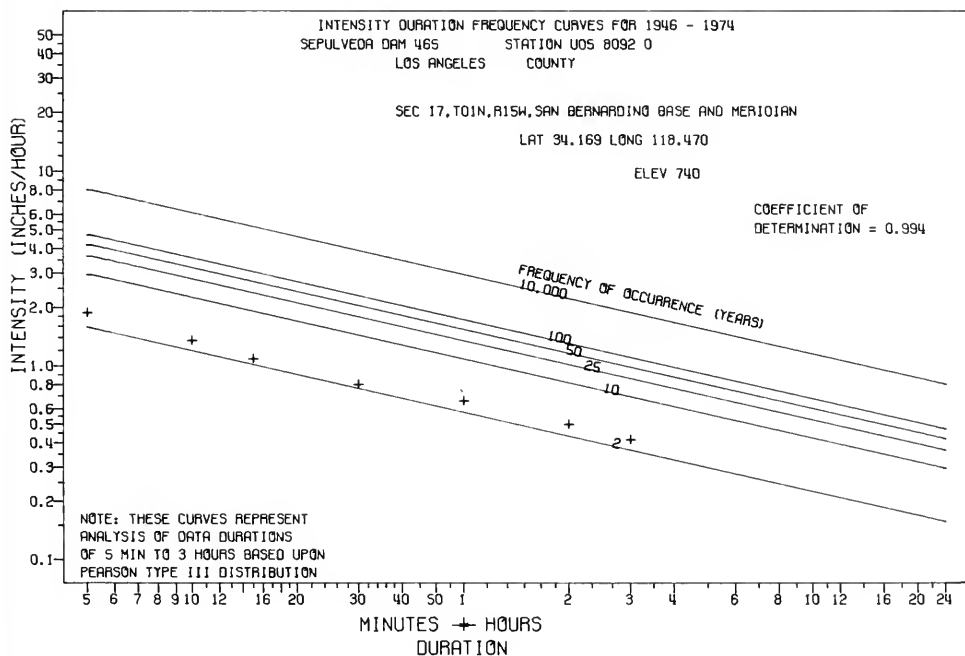
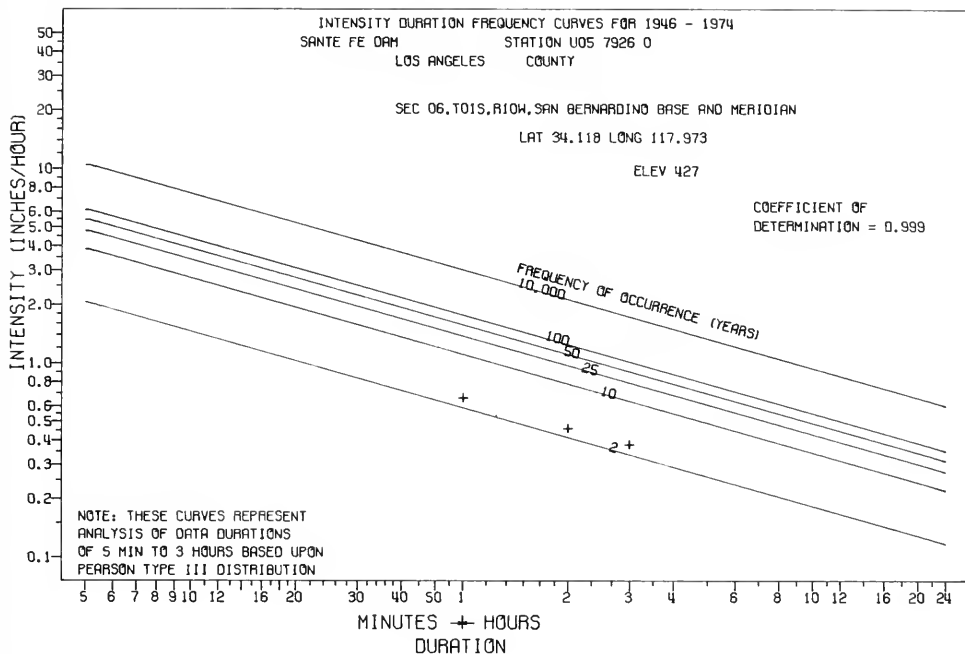
LAT 33.994 LONG 117.990

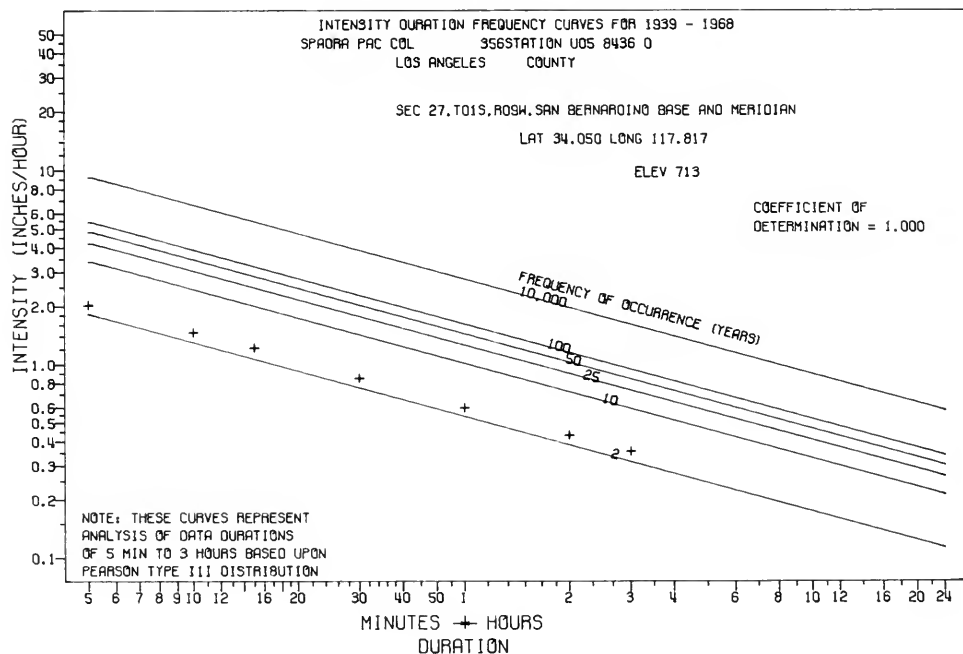
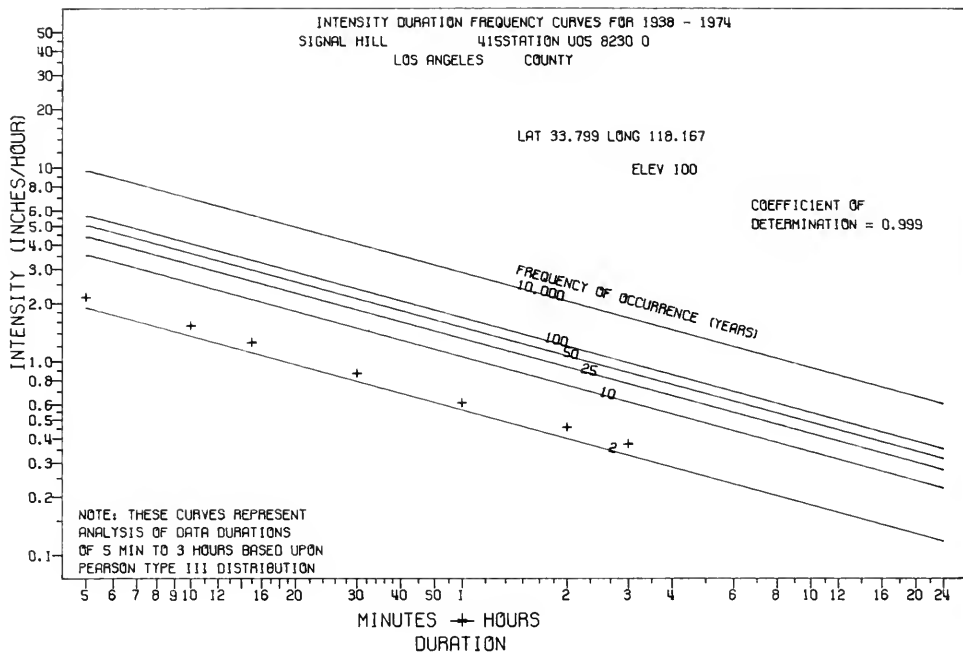
ELEV 860

COEFFICIENT OF
DETERMINATION = 0.999







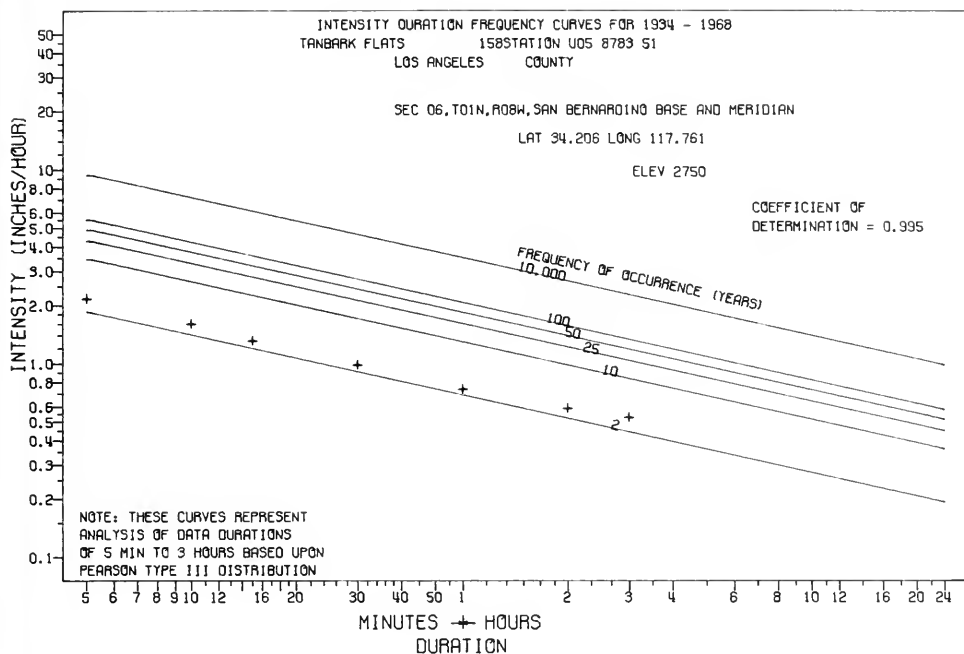


INTENSITY DURATION FREQUENCY CURVES FOR 1934 - 1968
TANBARK FLATS 158 STATION U05 8783 51
LOS ANGELES COUNTY

SEC 06, T01N, R08W, SAN BERNARDINO BASE AND MERIDIAN
LAT 34.206 LONG 117.761

ELEV 2750

COEFFICIENT OF
DETERMINATION = 0.995



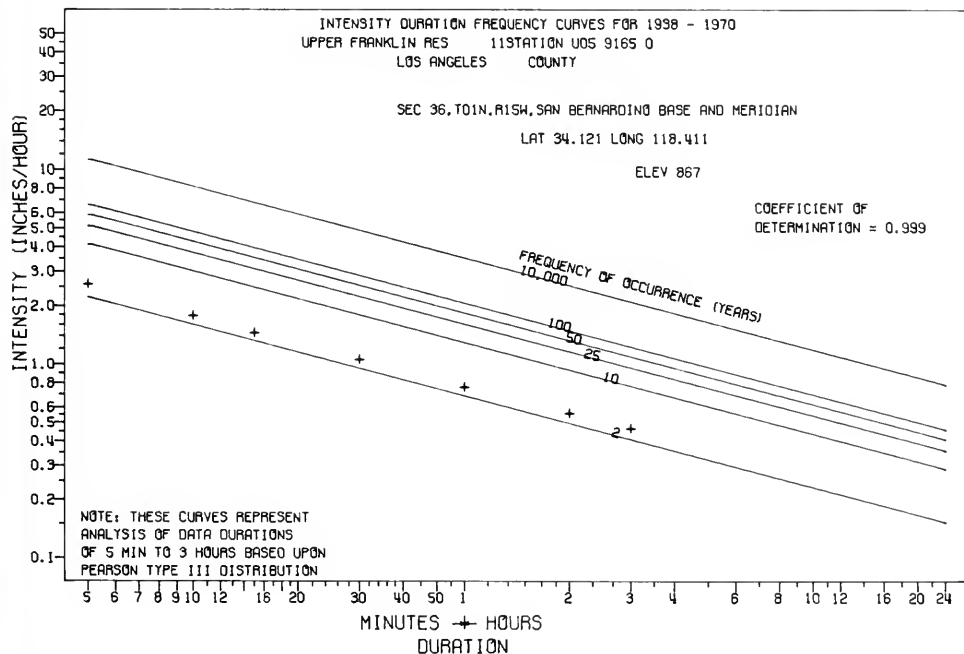
INTENSITY DURATION FREQUENCY CURVES FOR 1938 - 1970
UPPER FRANKLIN RES 111 STATION U05 9165 0
LOS ANGELES COUNTY

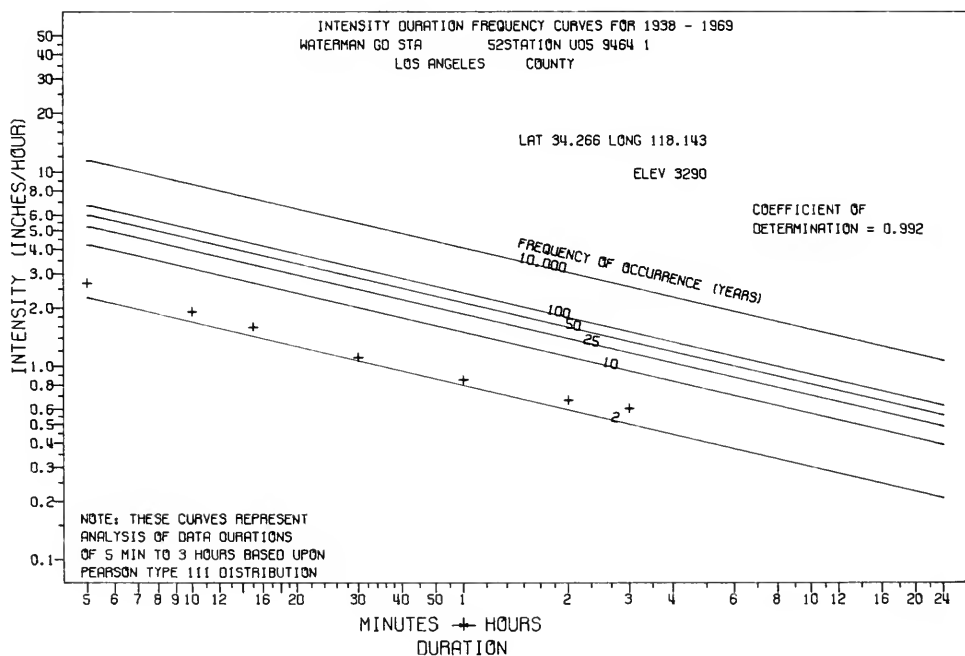
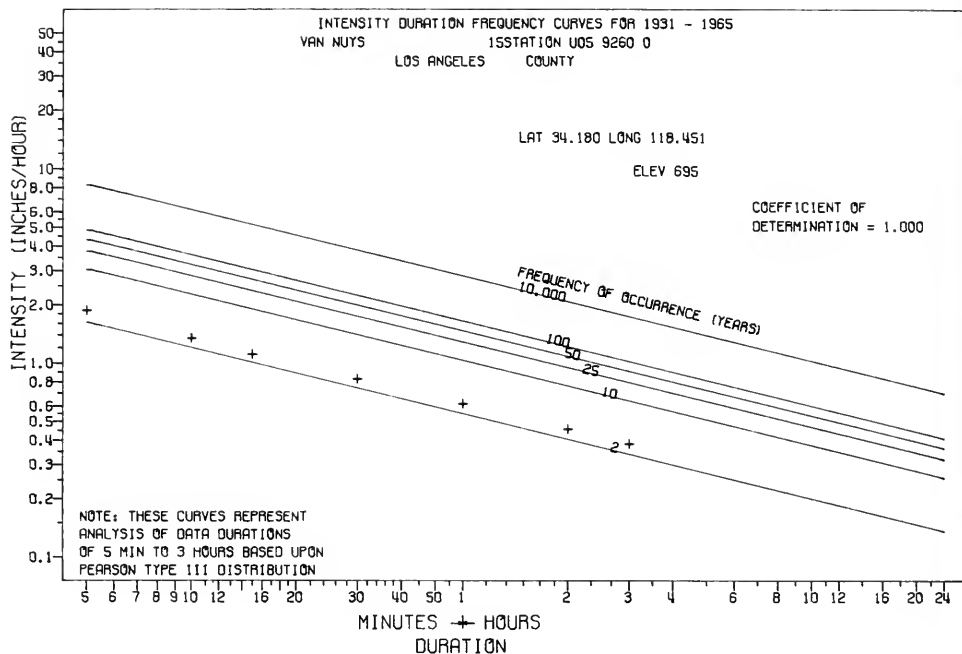
SEC 36, T01N, R15W, SAN BERNARDINO BASE AND MERIDIAN

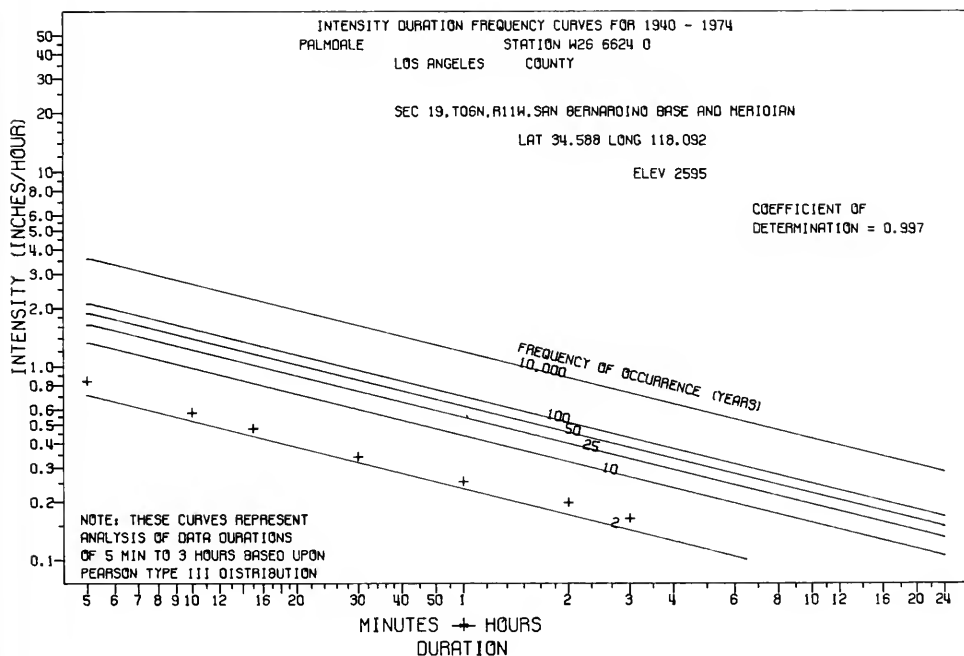
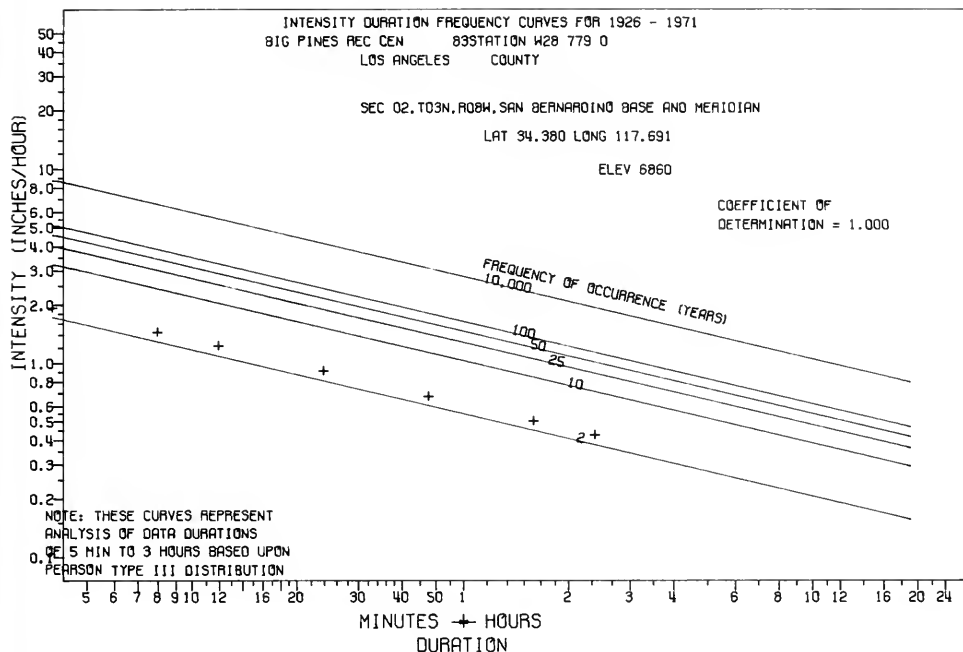
LAT 34.121 LONG 118.411

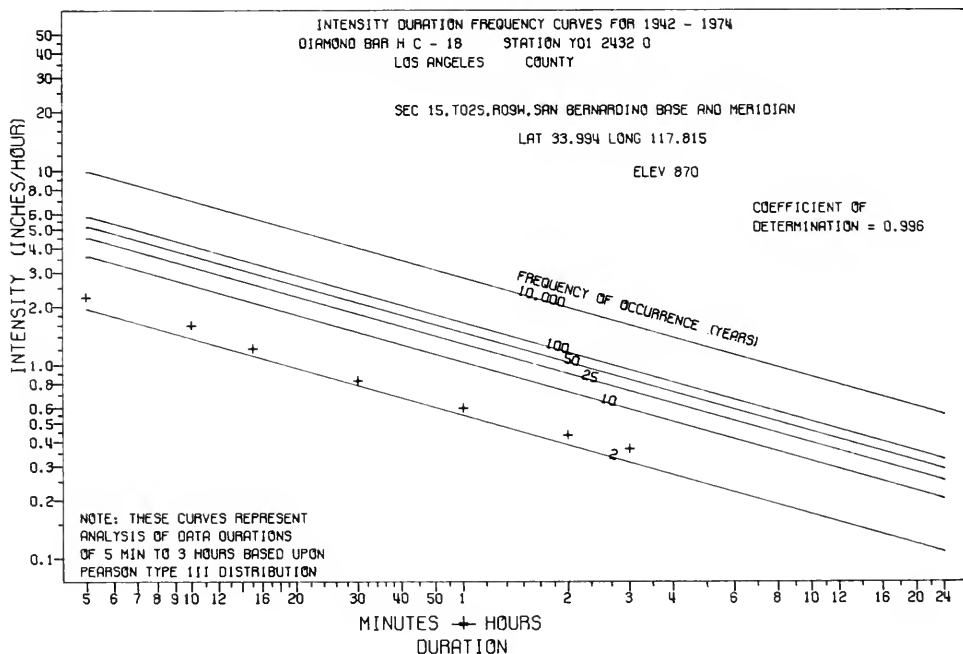
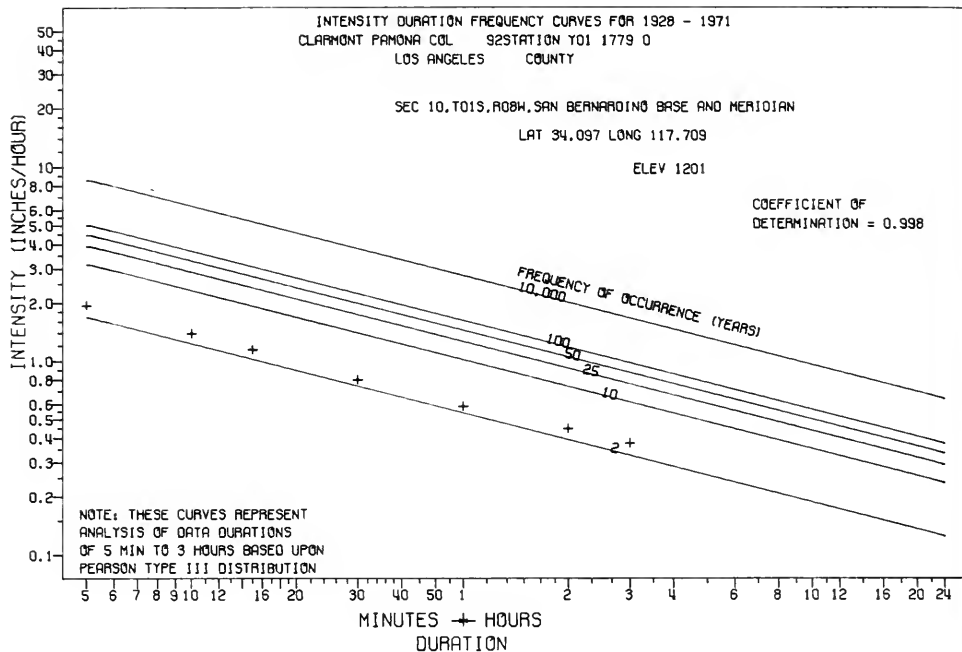
ELEV 867

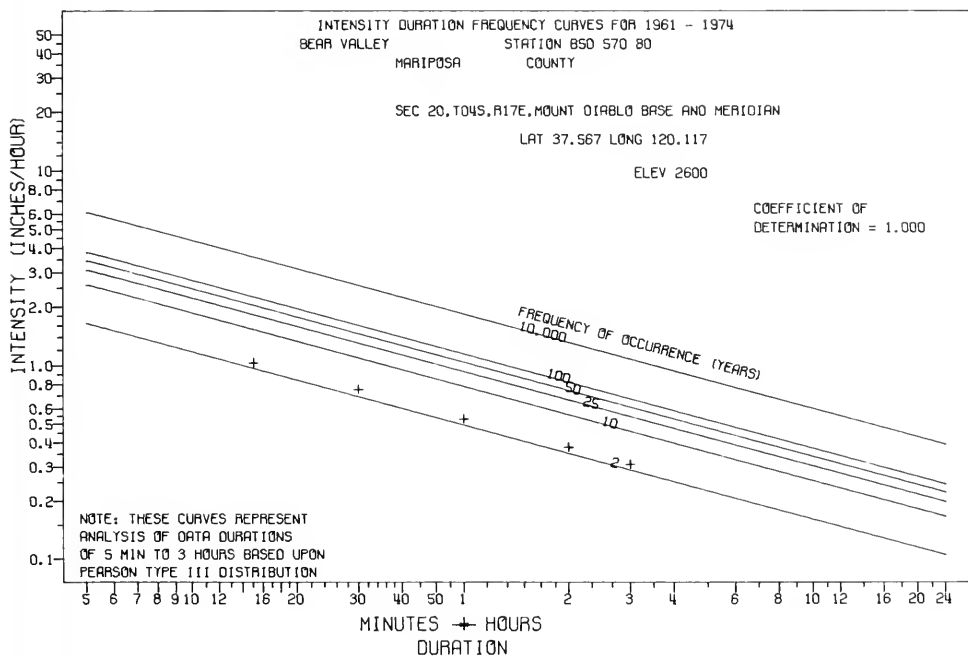
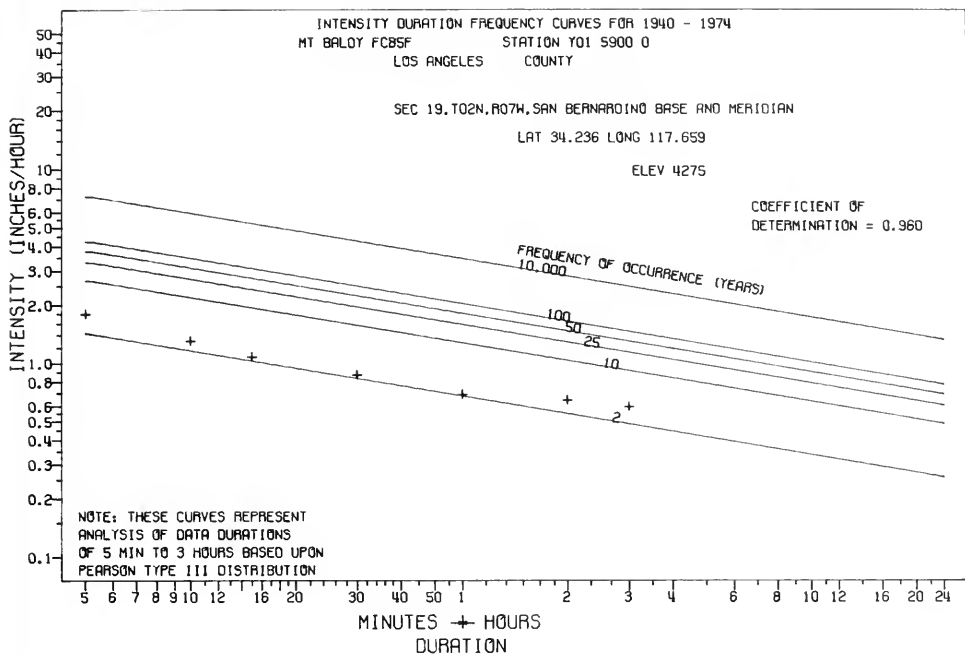
COEFFICIENT OF
DETERMINATION = 0.999

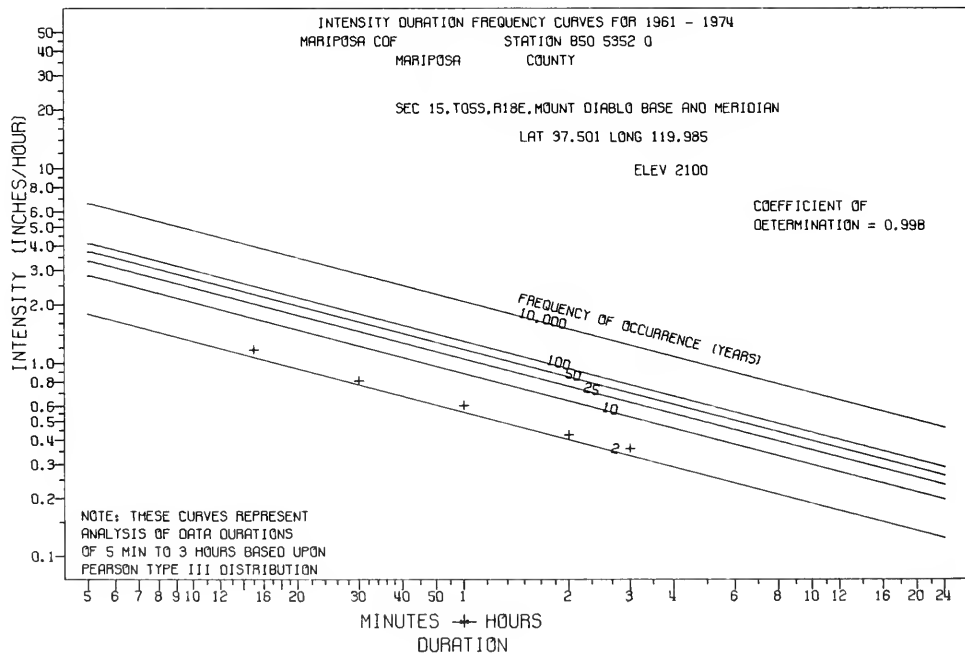
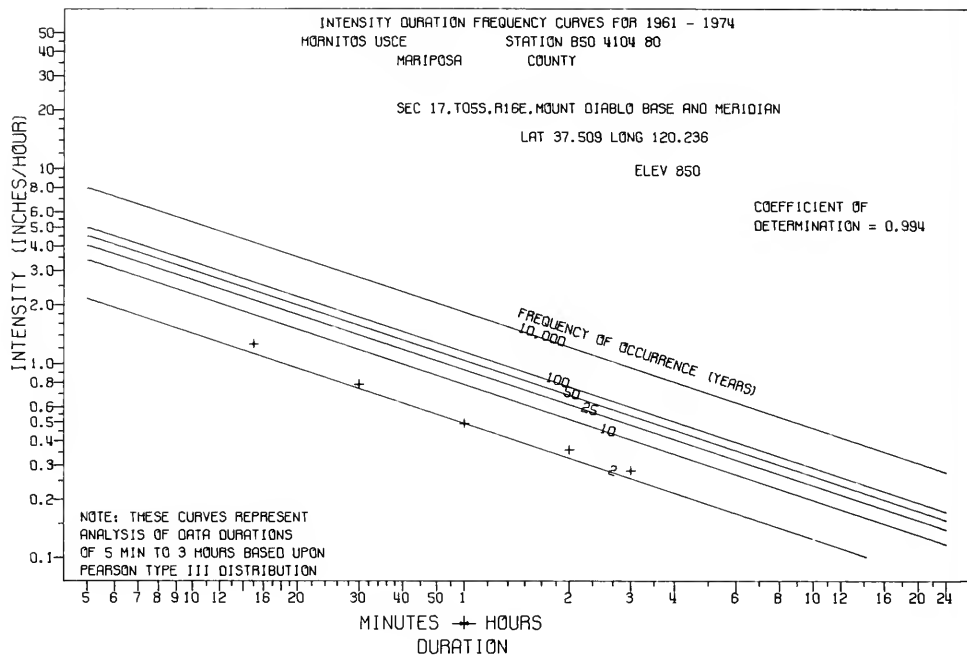


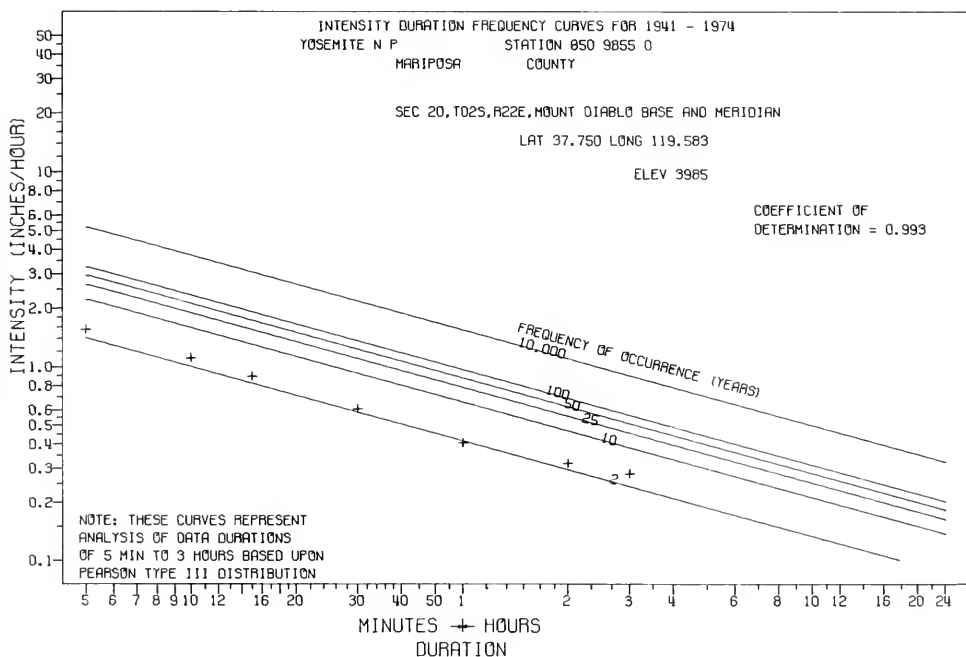
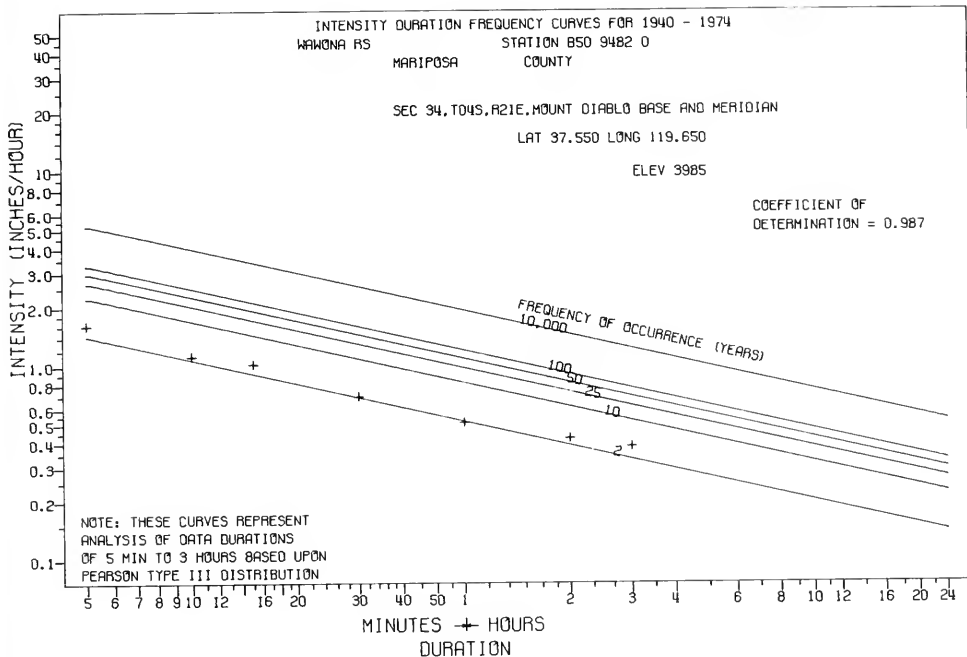


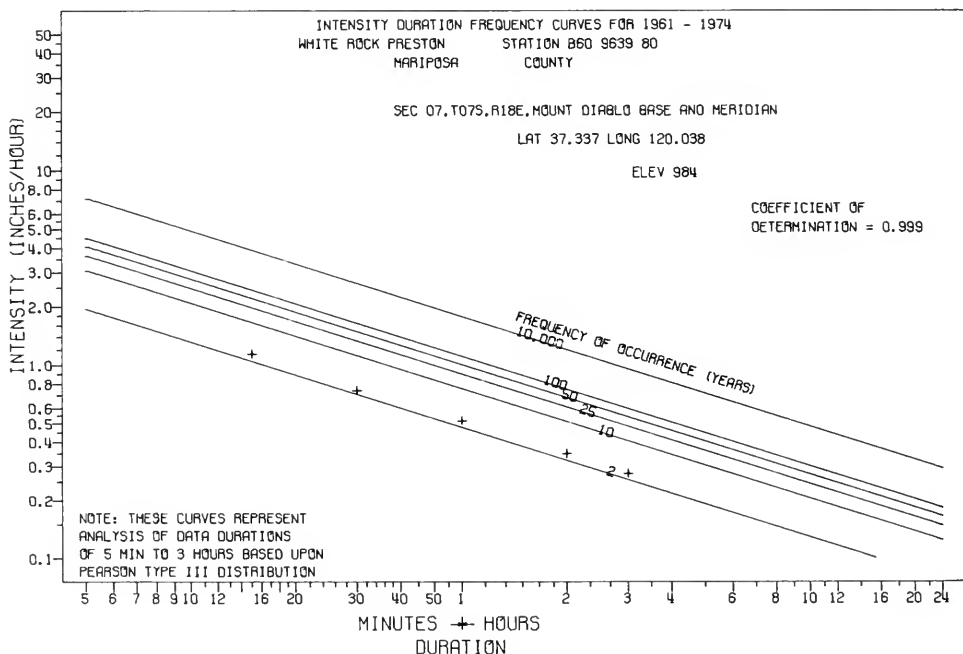
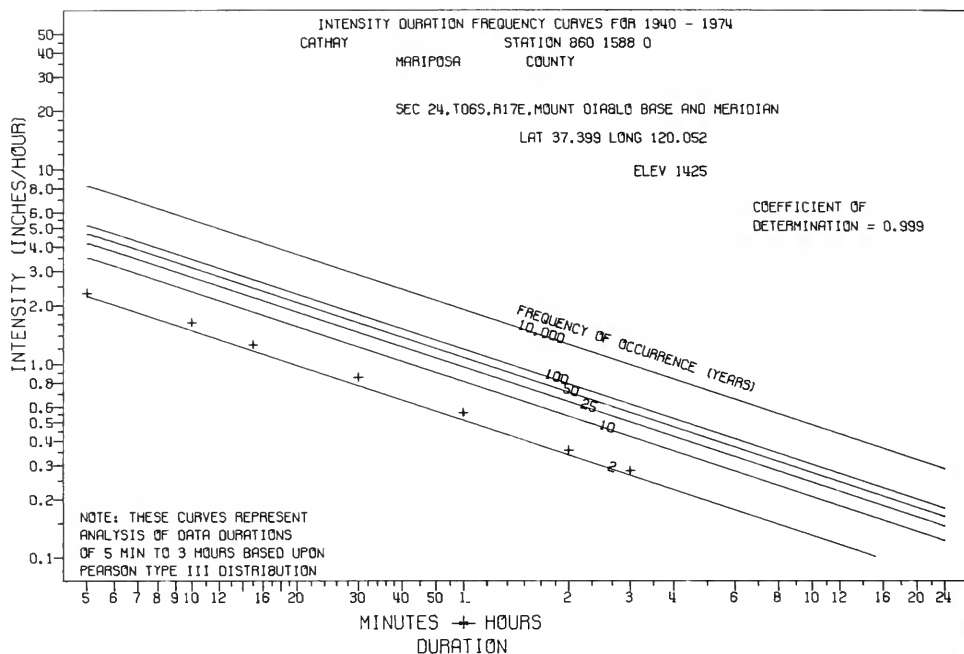


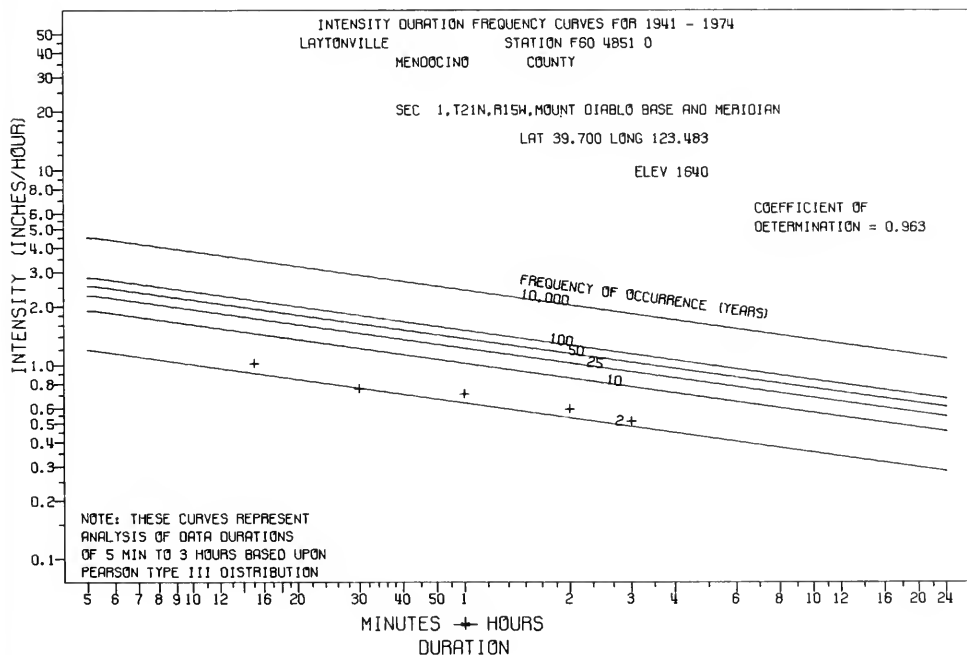
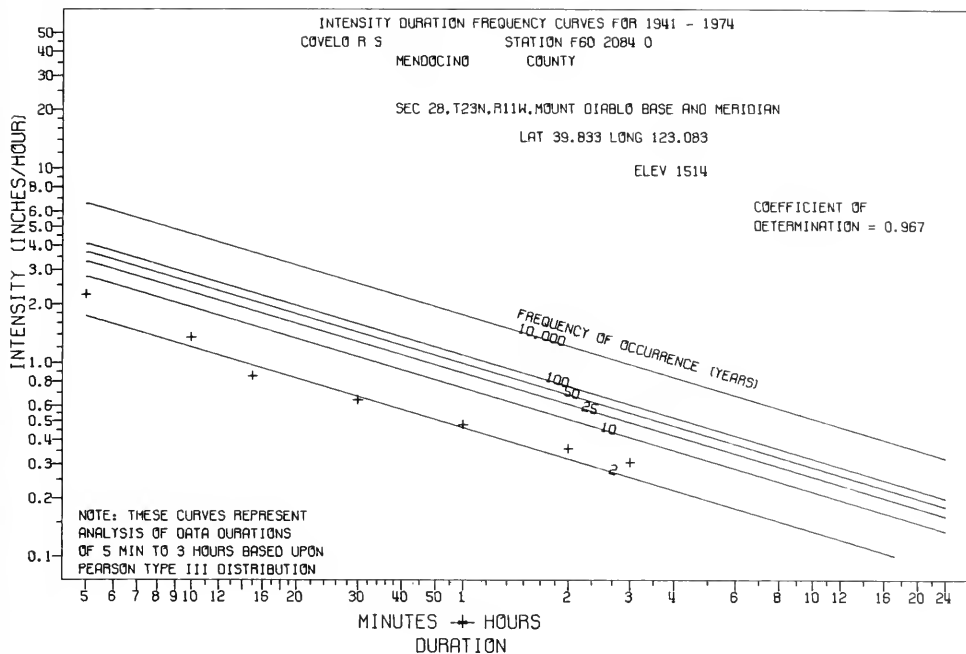


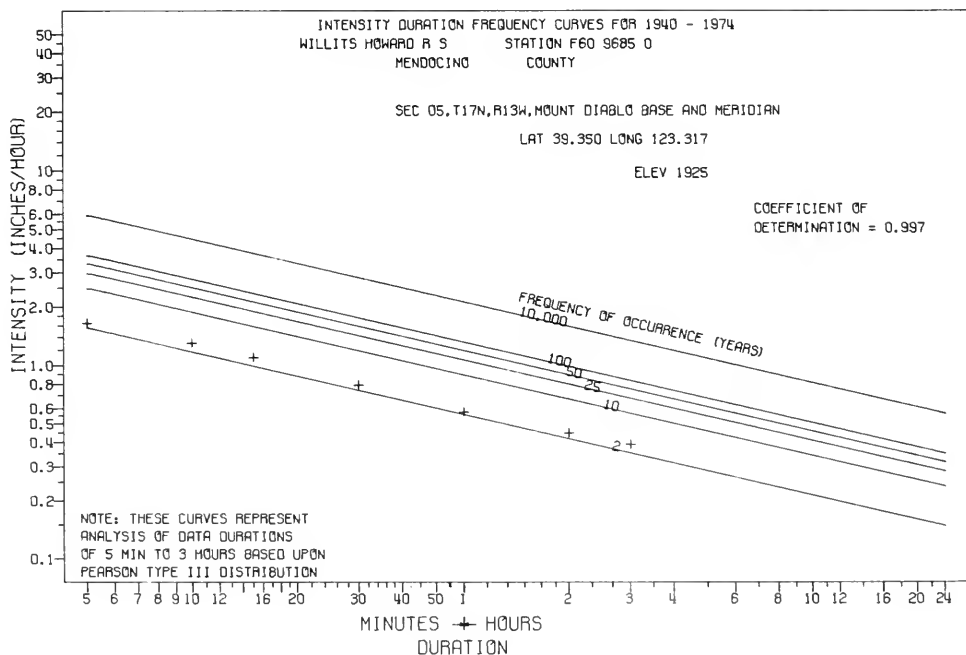
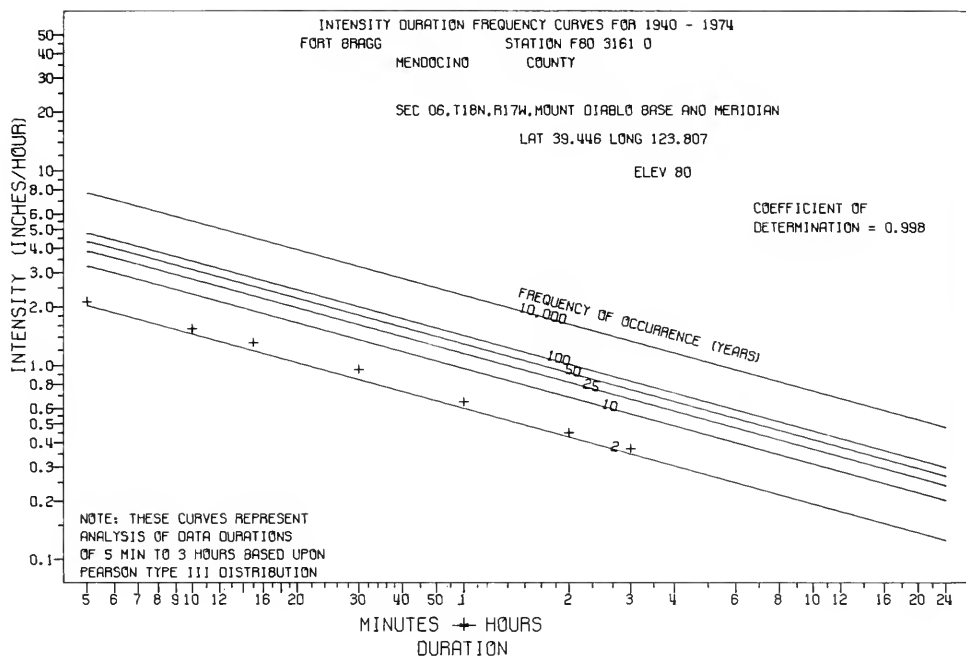


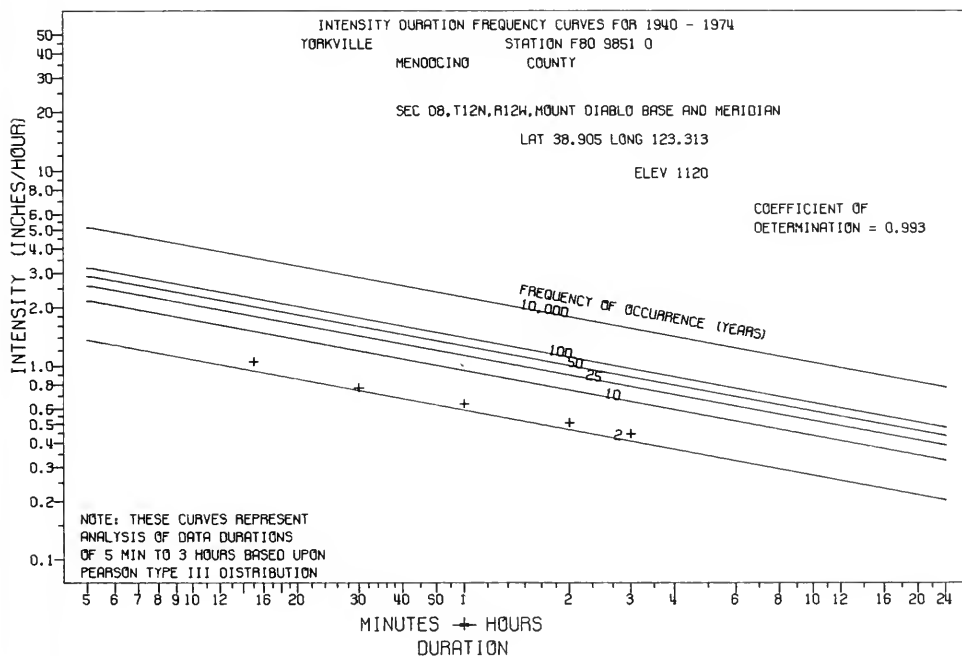
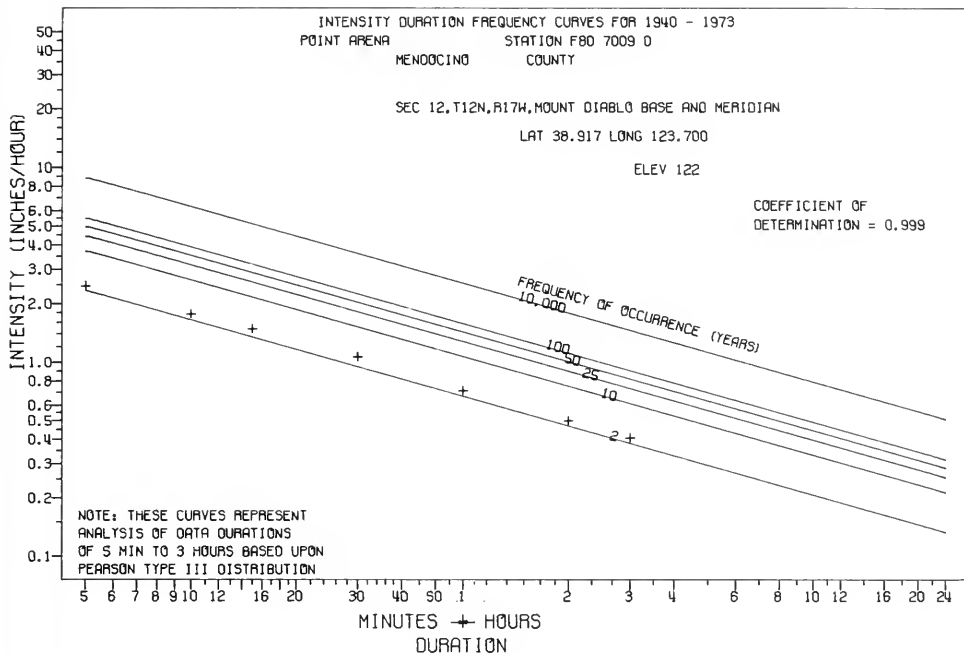


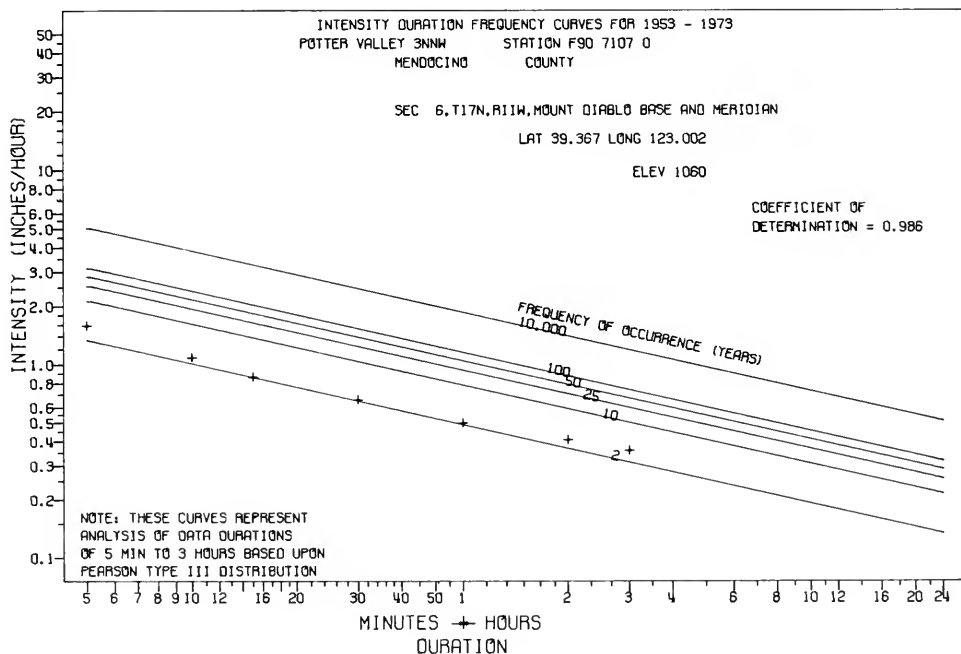
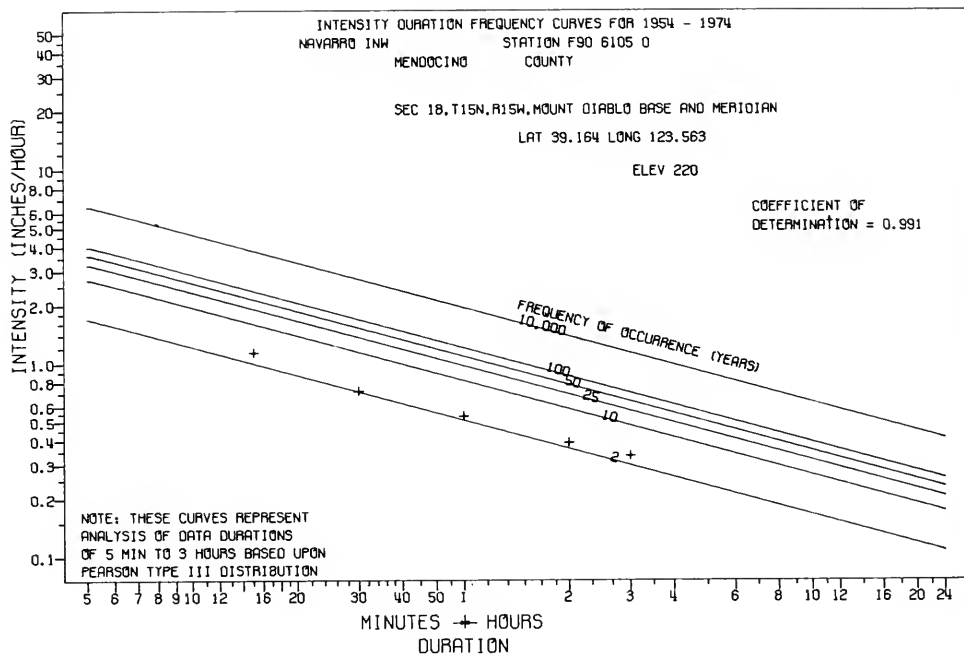












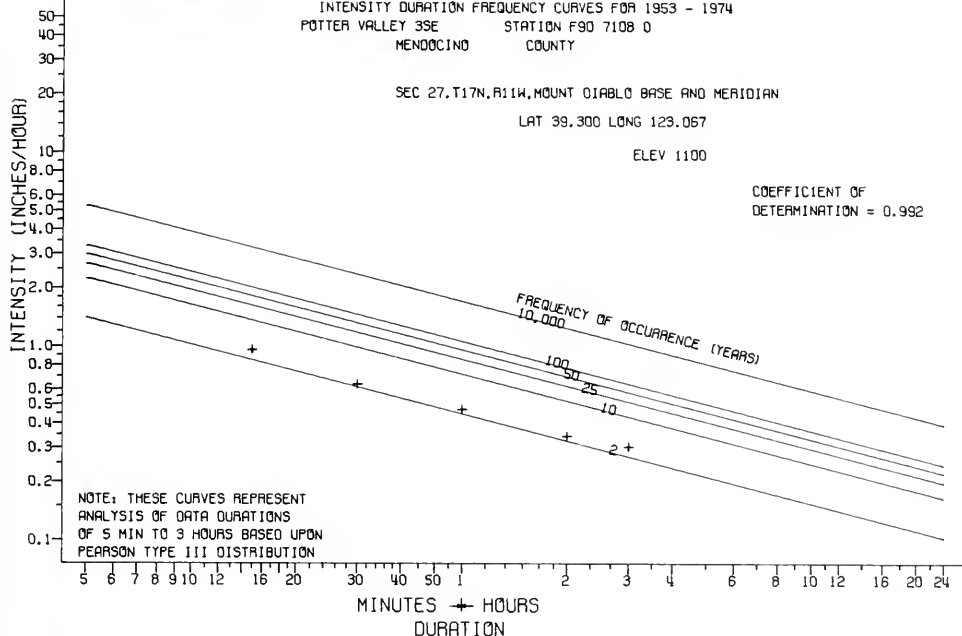
INTENSITY DURATION FREQUENCY CURVES FOR 1953 - 1974
POTTER VALLEY SSE STATION F90 7108 0
MENDOCINO COUNTY

SEC 27, T17N, R11W, MOUNT DIABLO BASE AND MERIDIAN

LAT 39.300 LONG 123.067

ELEV 1100

COEFFICIENT OF
DETERMINATION = 0.992



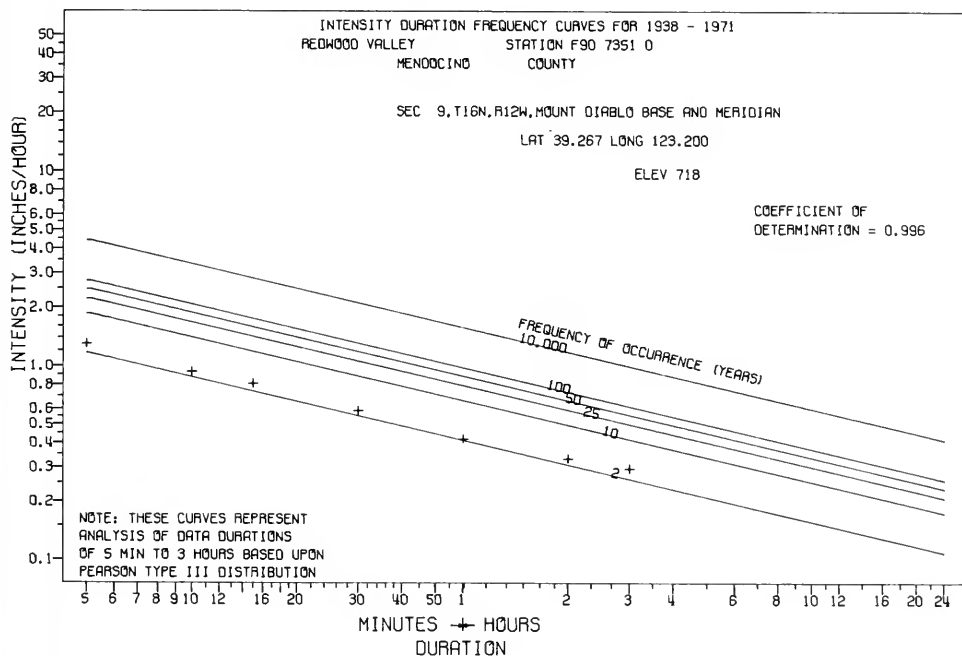
INTENSITY DURATION FREQUENCY CURVES FOR 1938 - 1971
REDWOOD VALLEY STATION F90 7351 0
MENDOCINO COUNTY

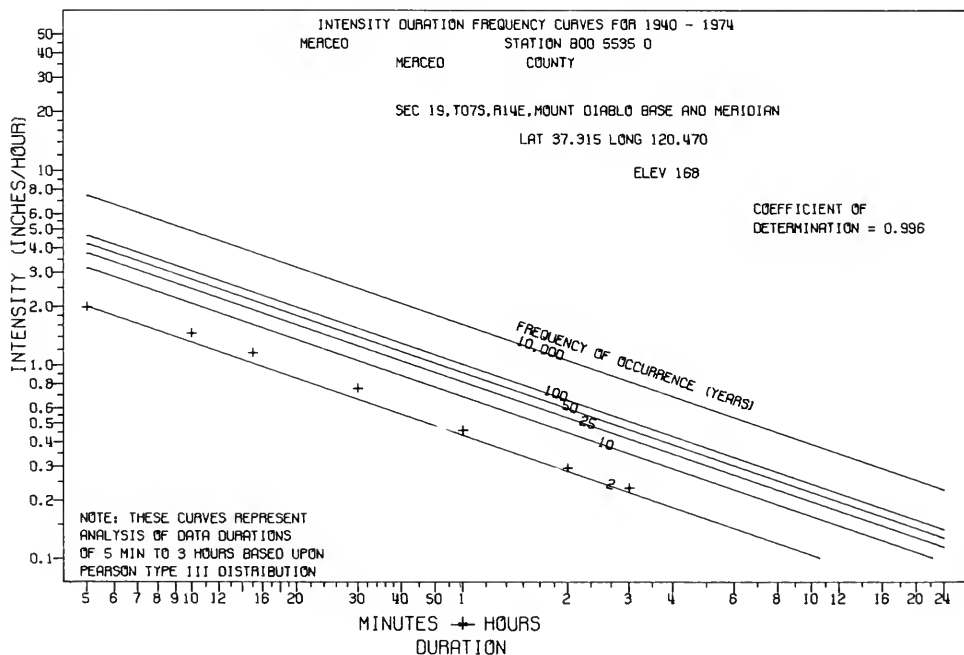
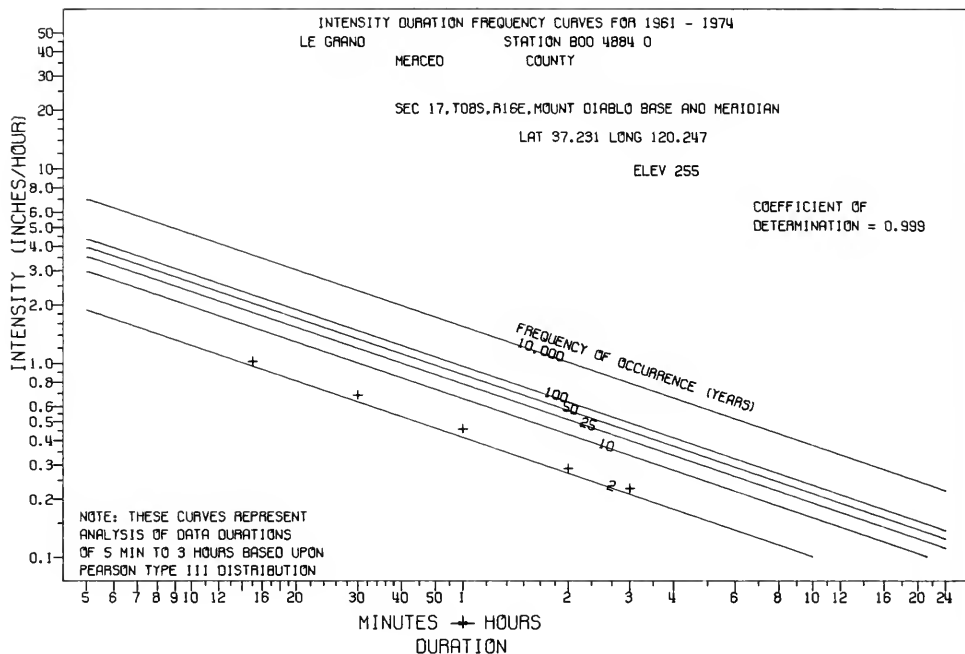
SEC 9, T16N, R12W, MOUNT DIABLO BASE AND MERIDIAN

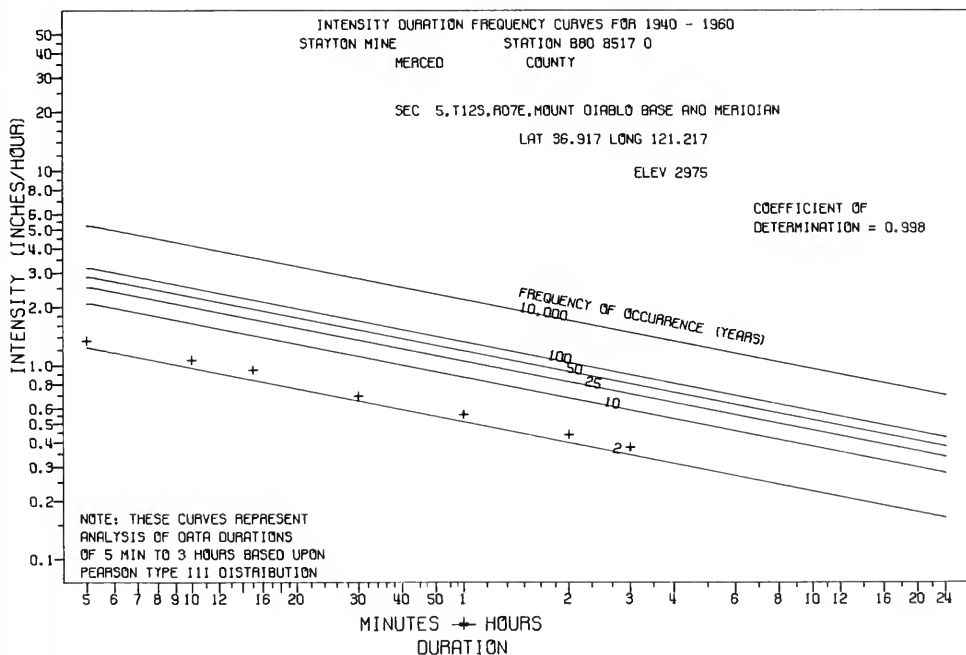
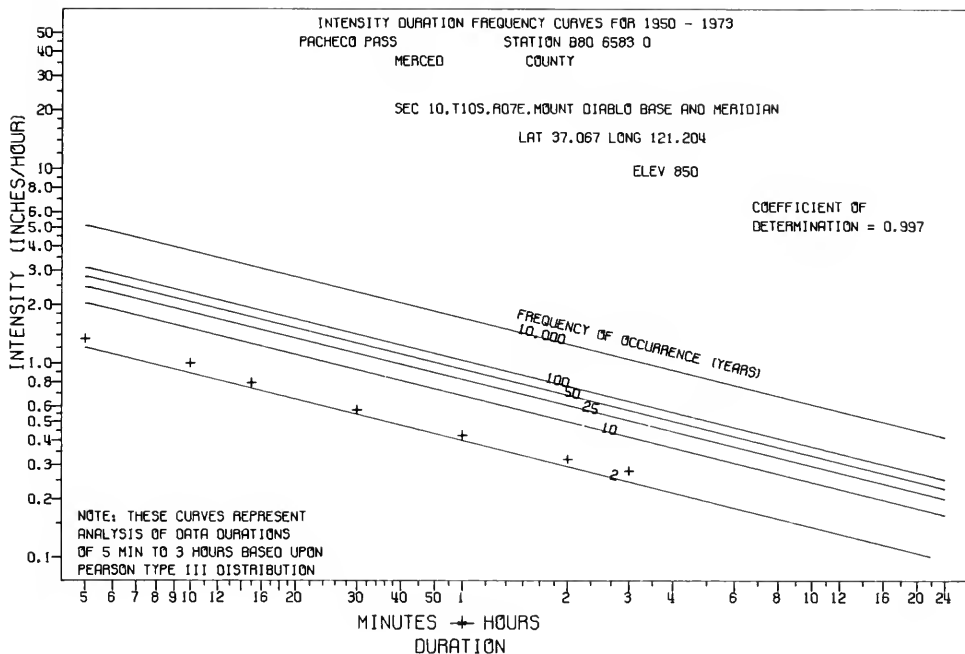
LAT 39.267 LONG 123.200

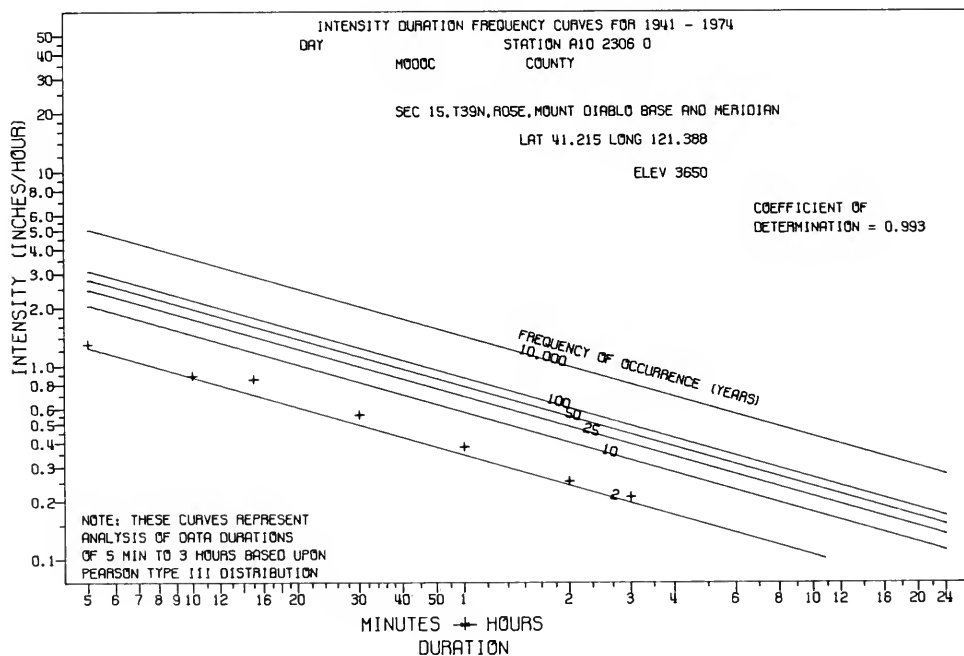
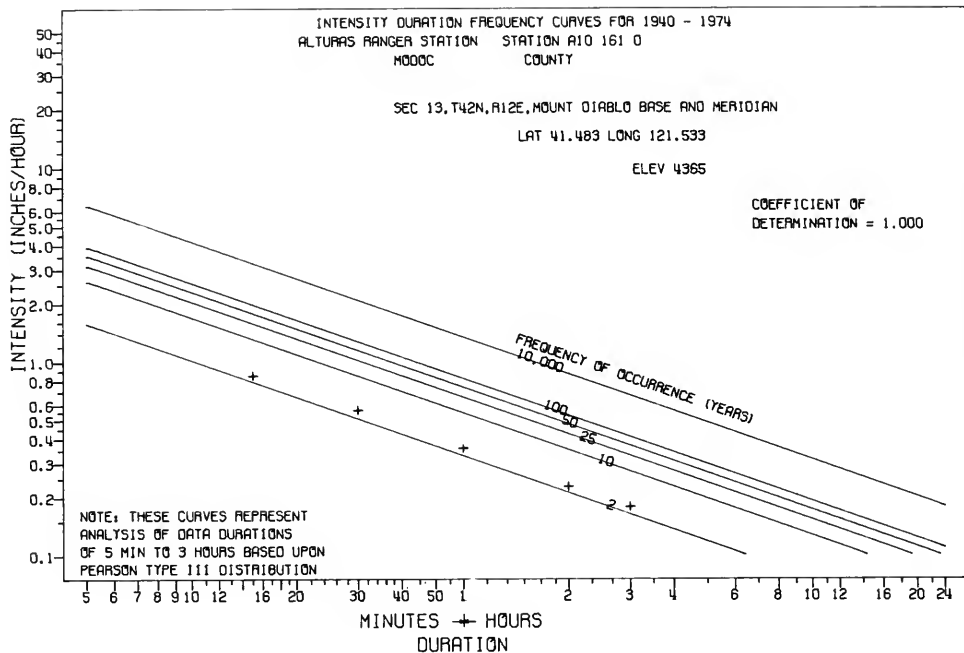
ELEV 718

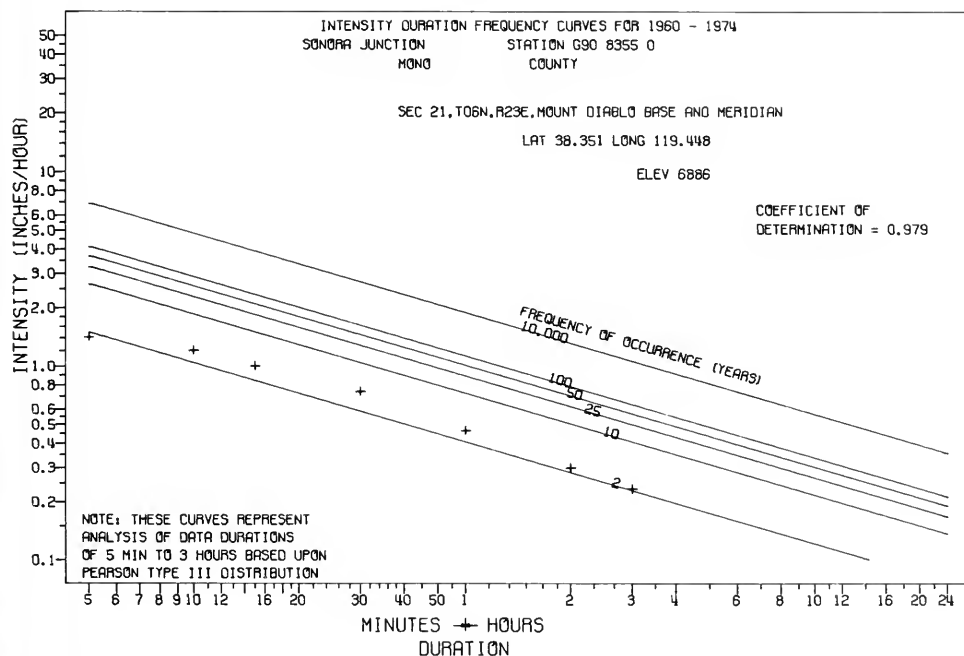
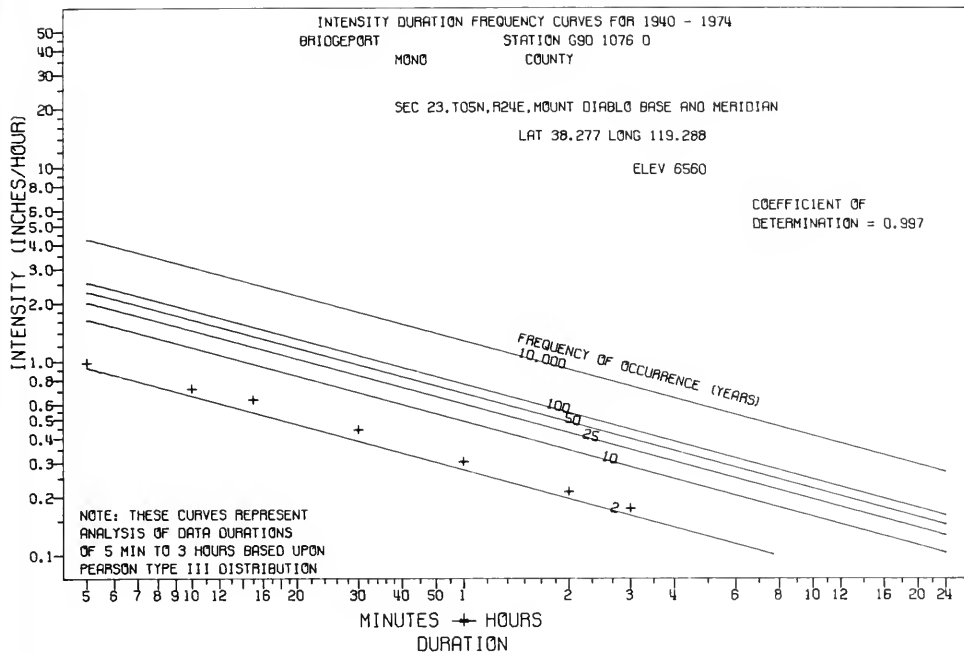
COEFFICIENT OF
DETERMINATION = 0.996

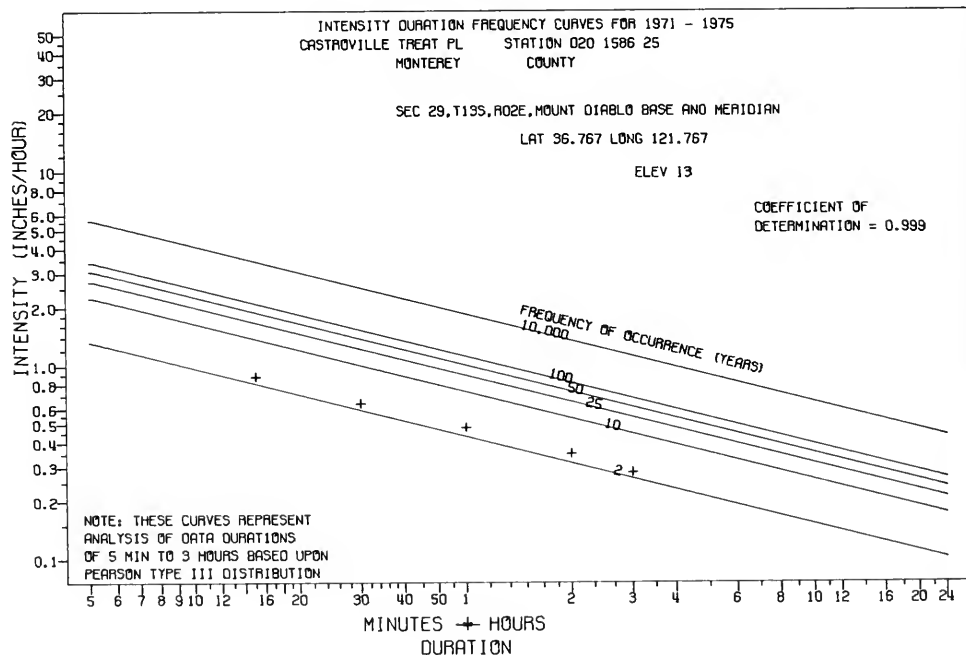
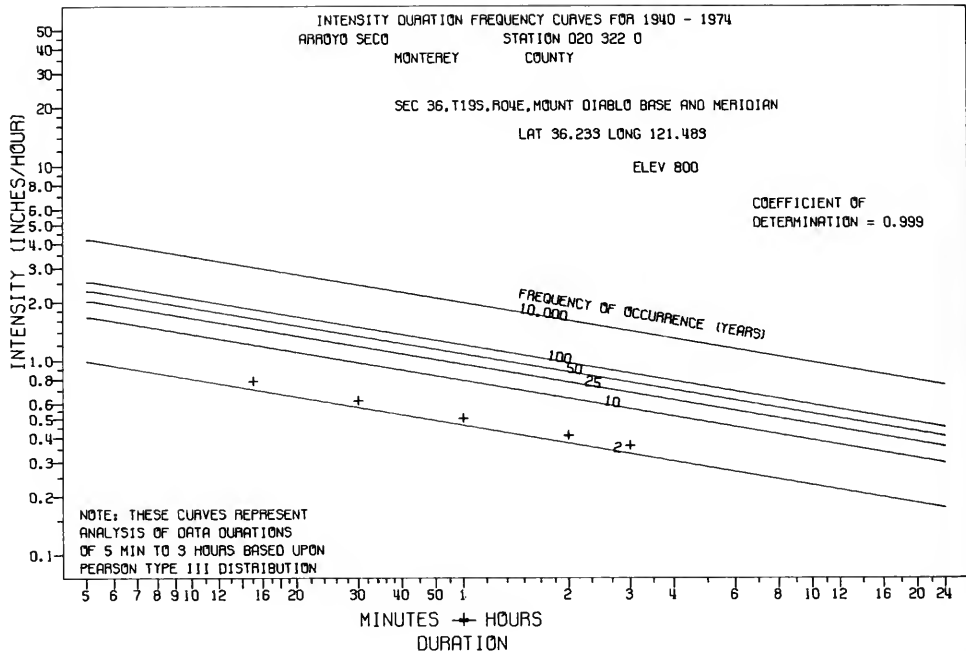


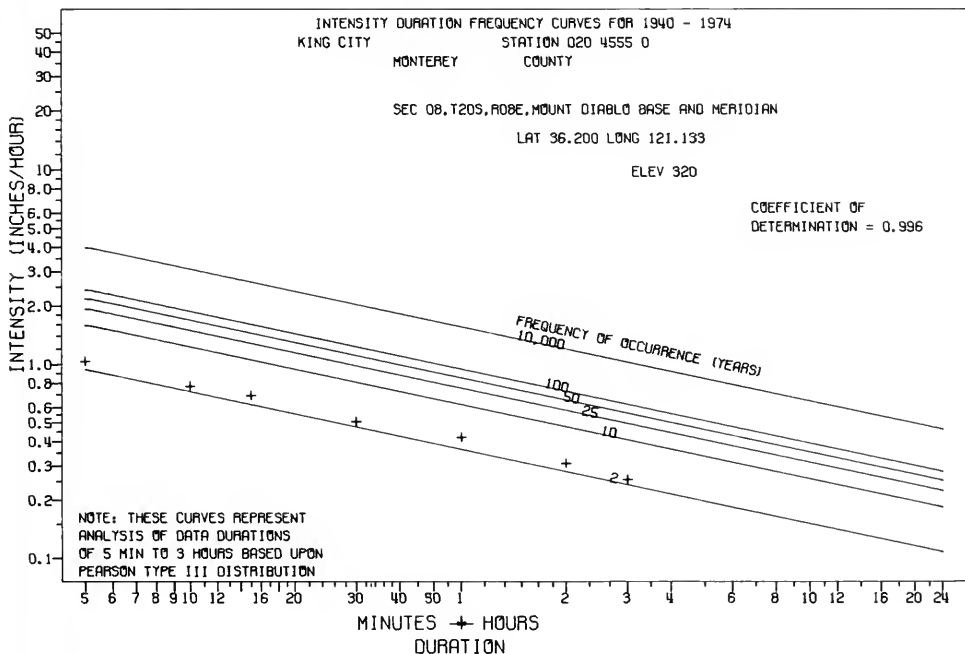
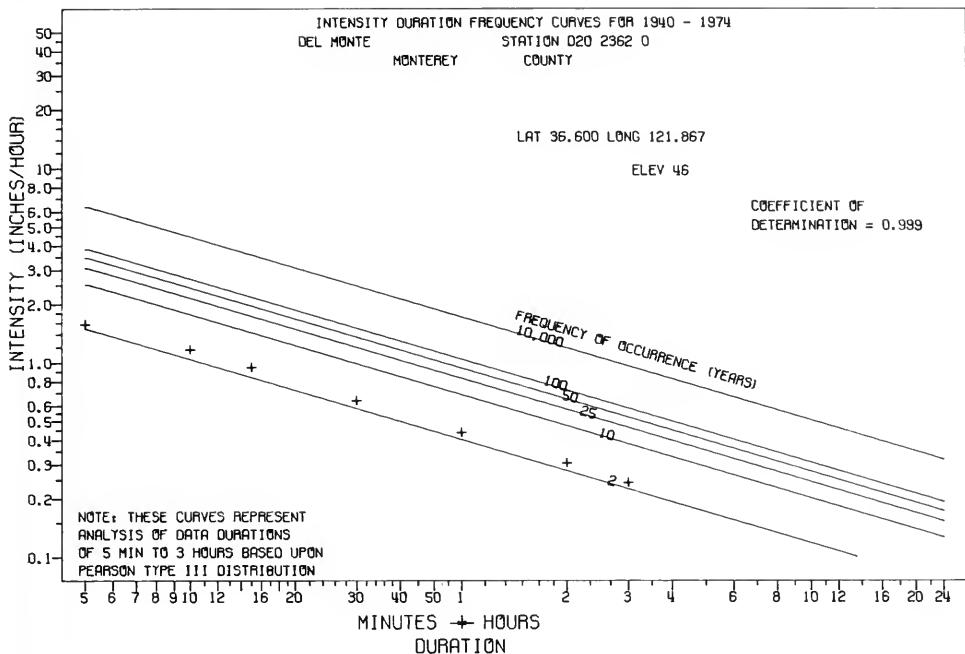


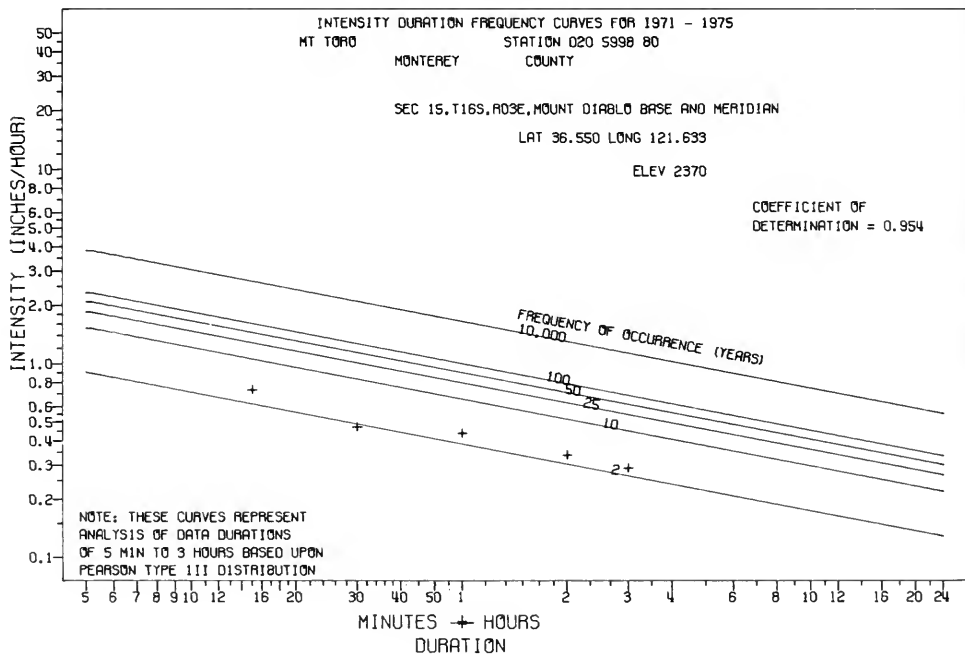
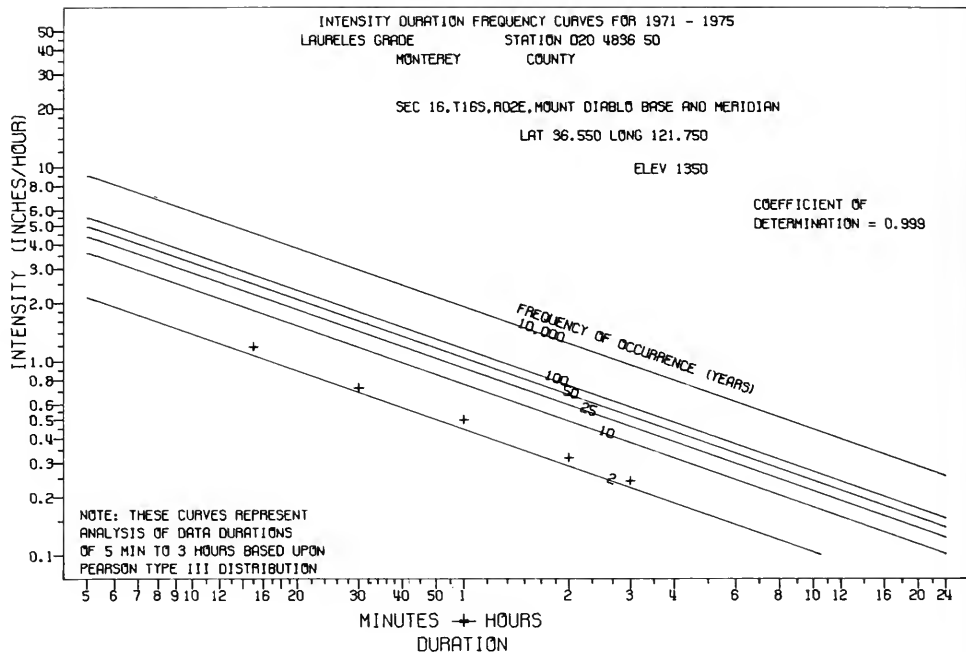


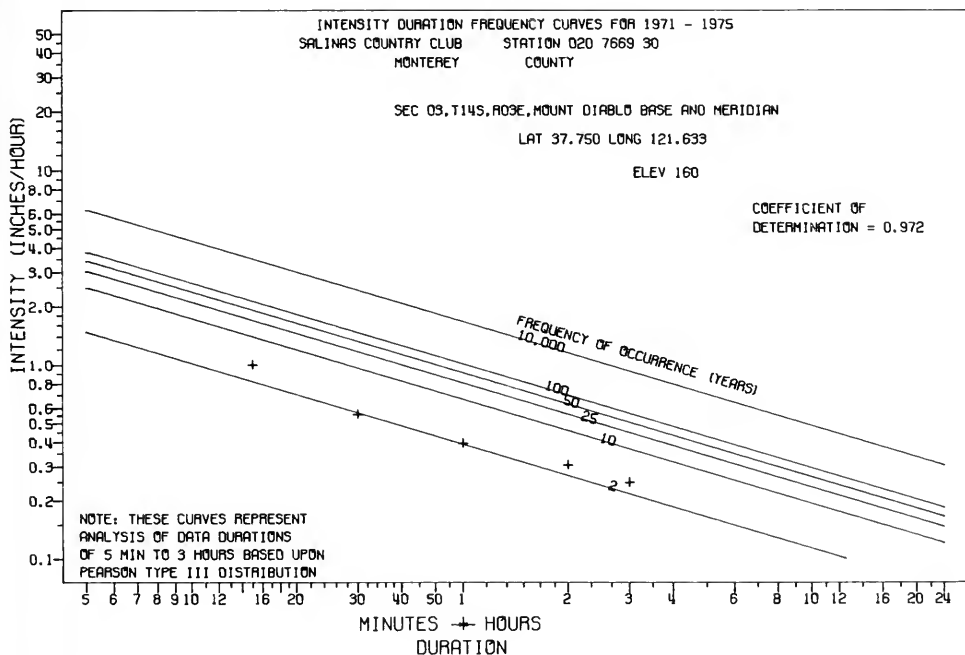
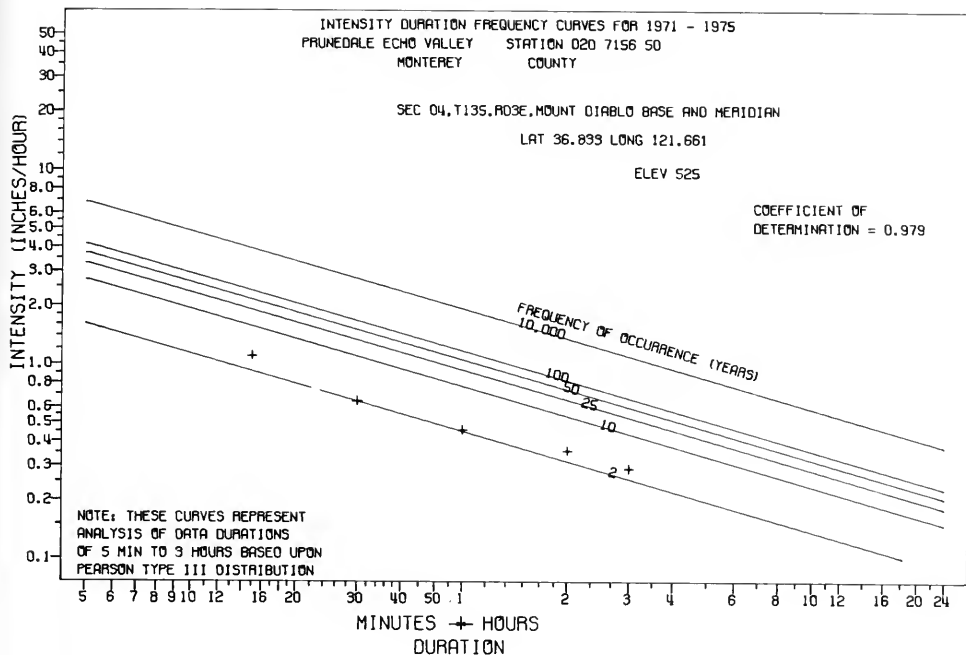


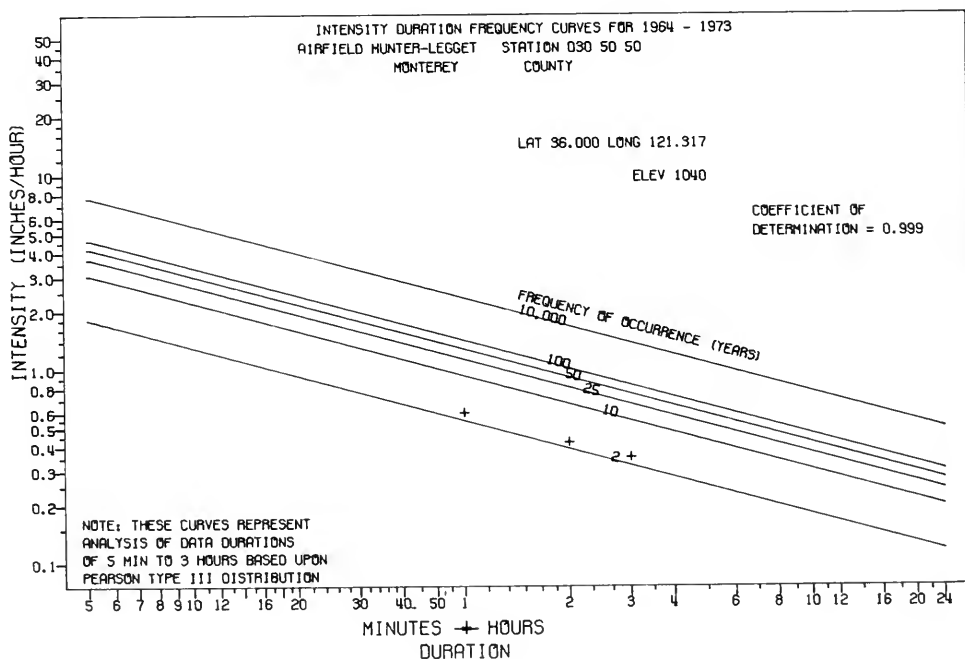
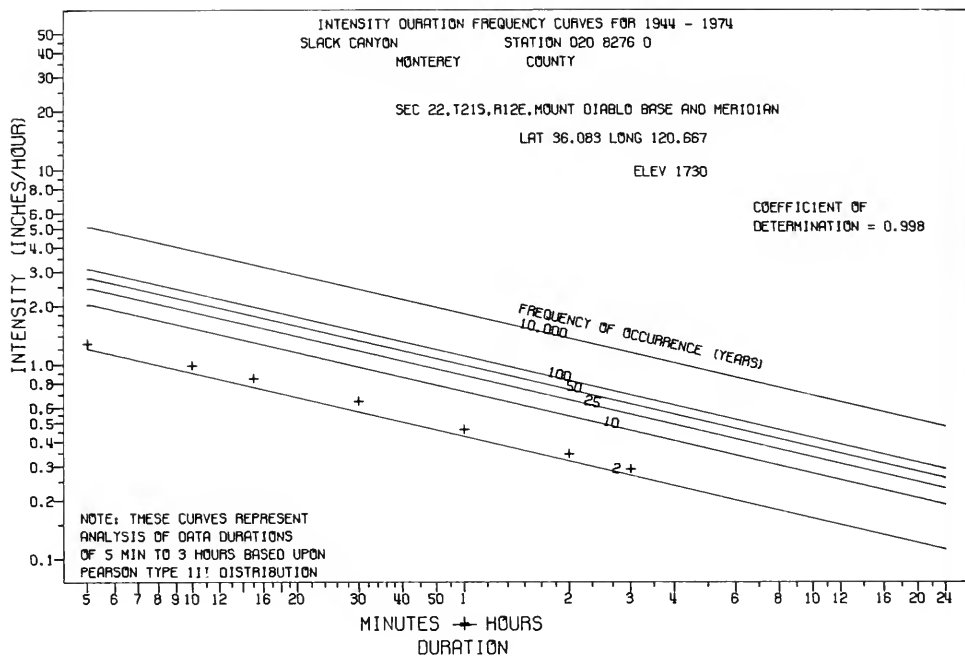


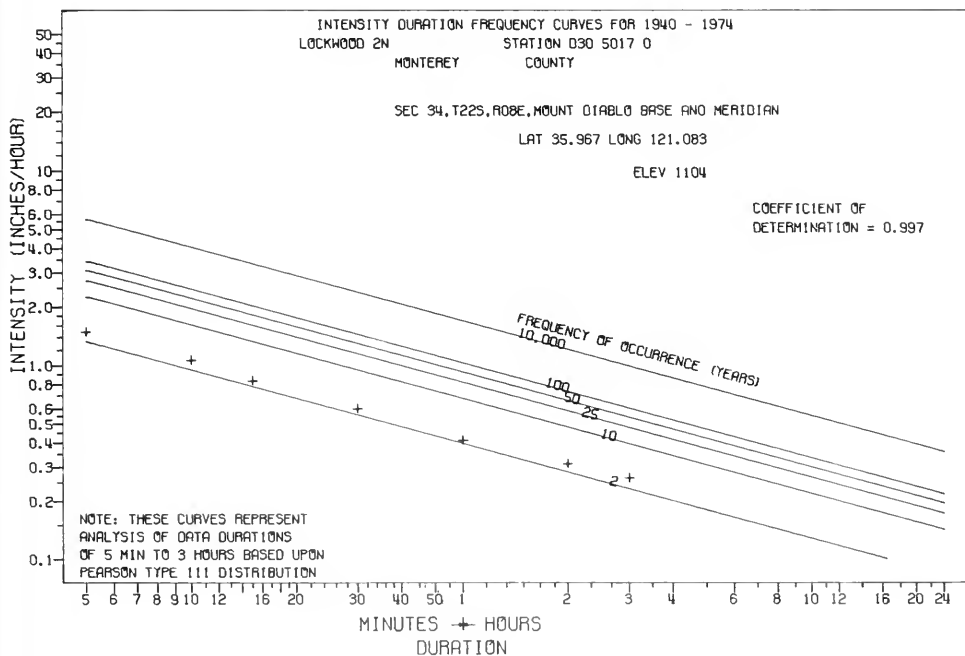
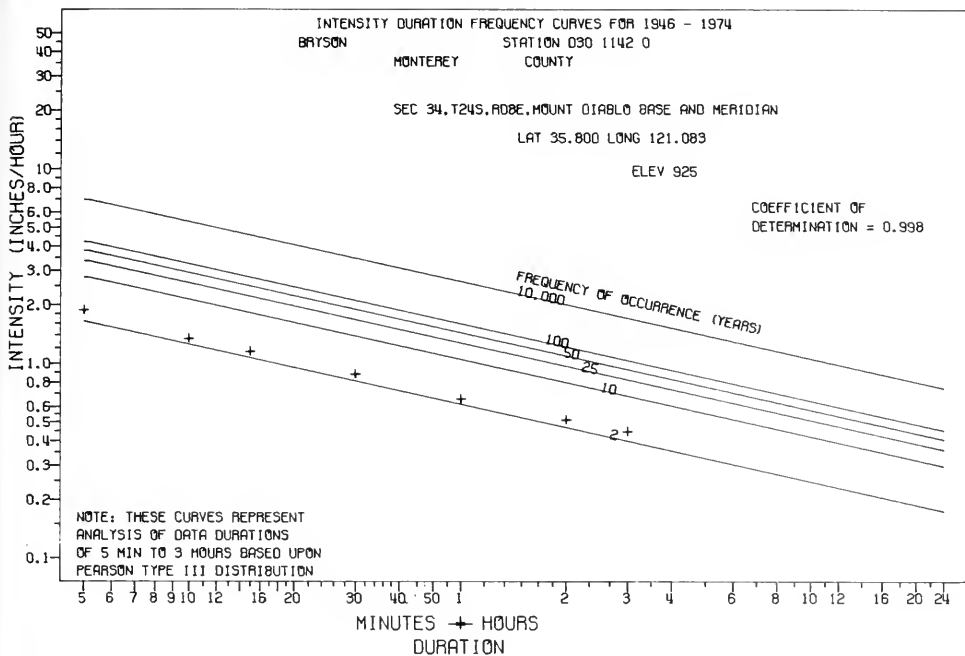


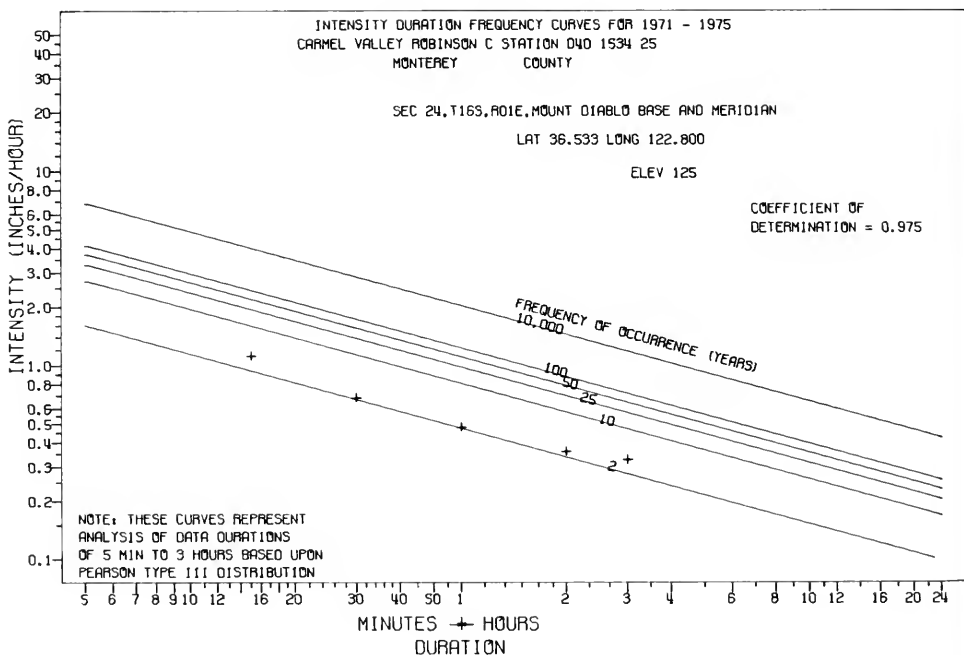
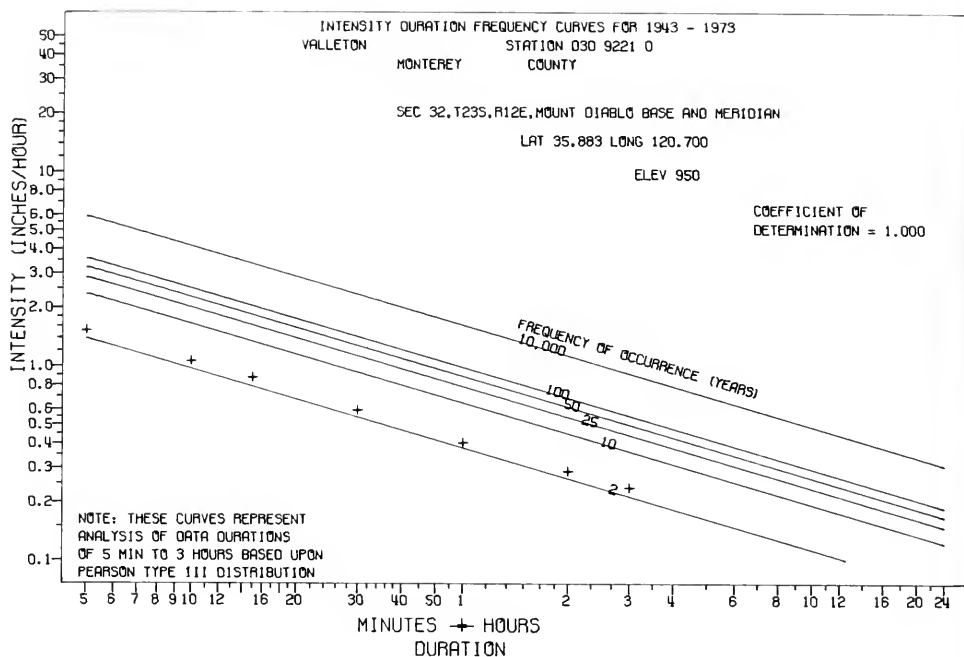


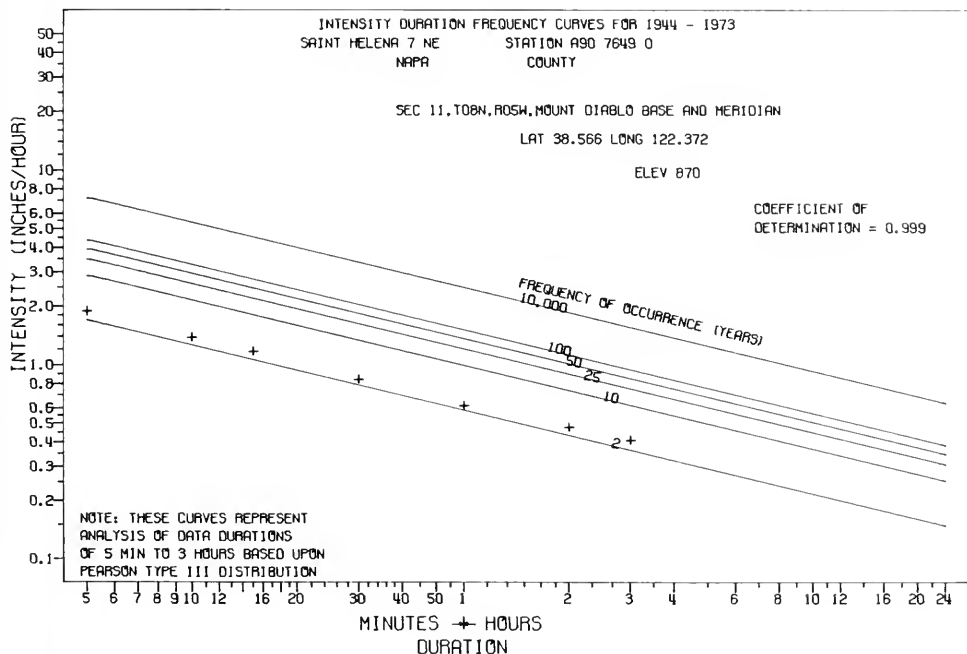
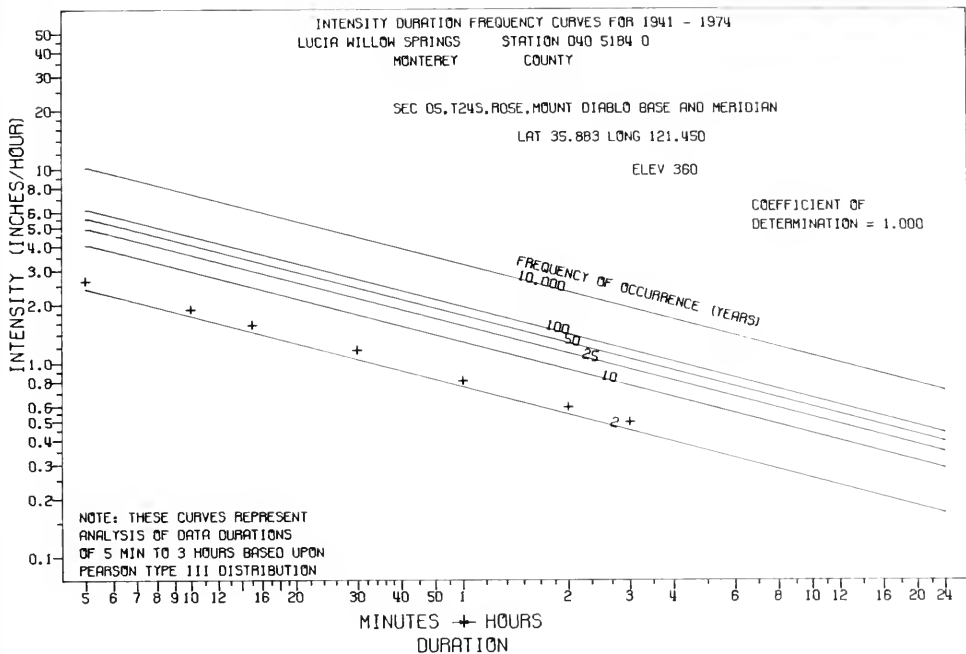


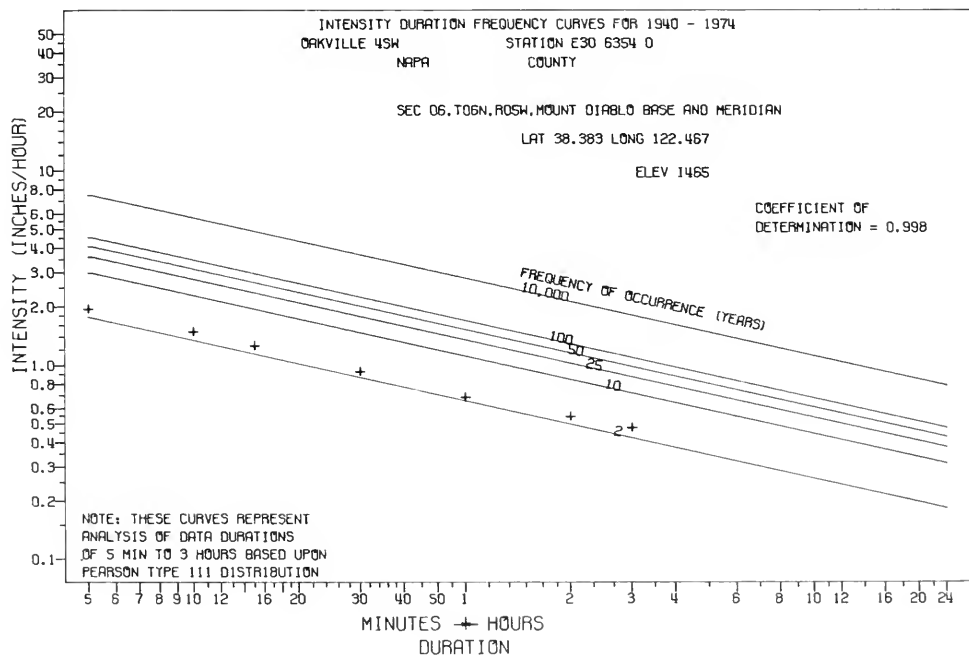
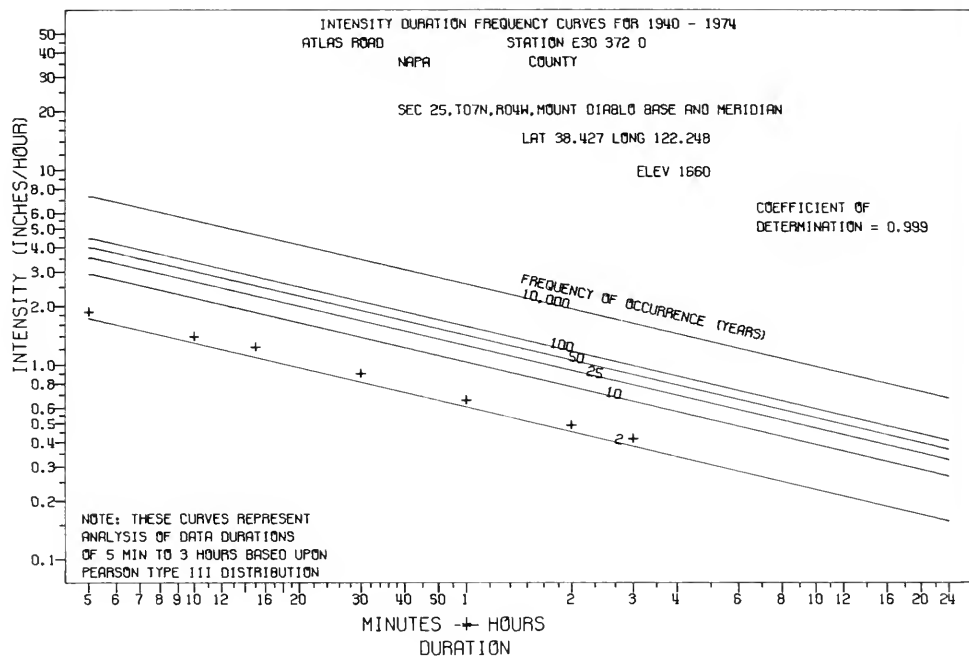


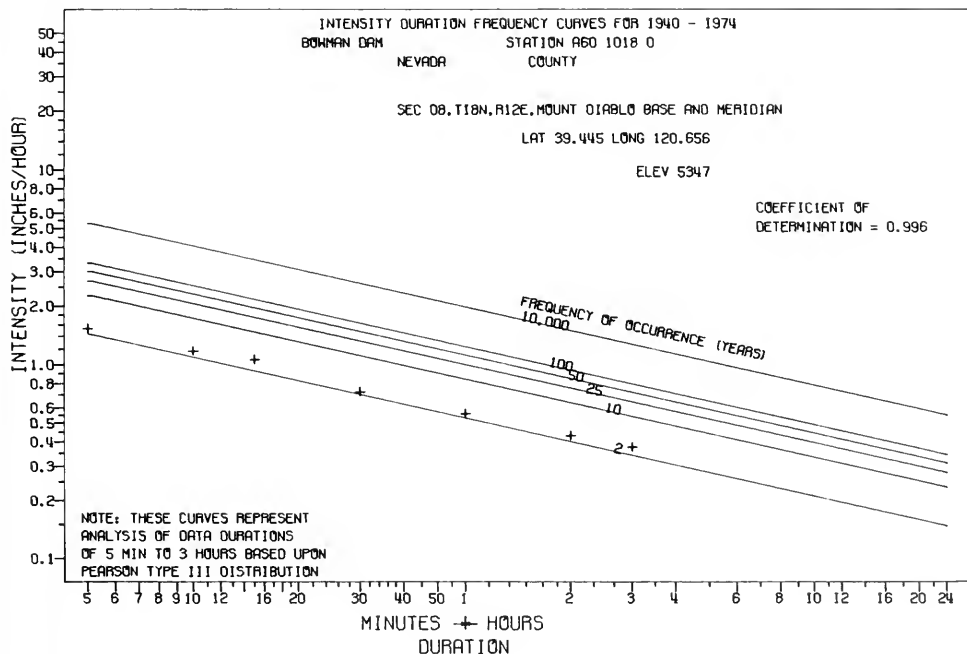
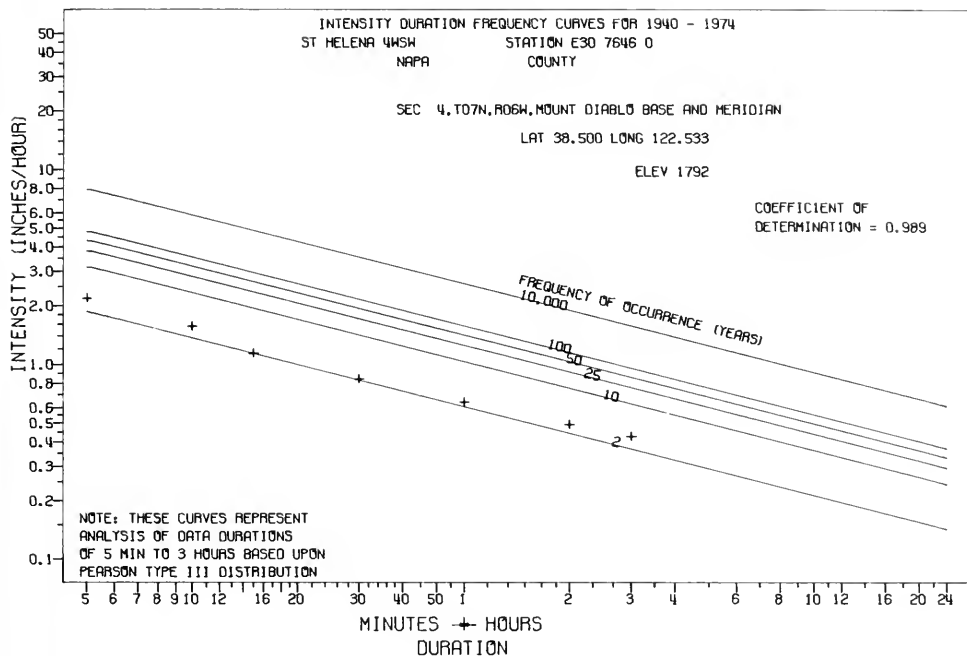


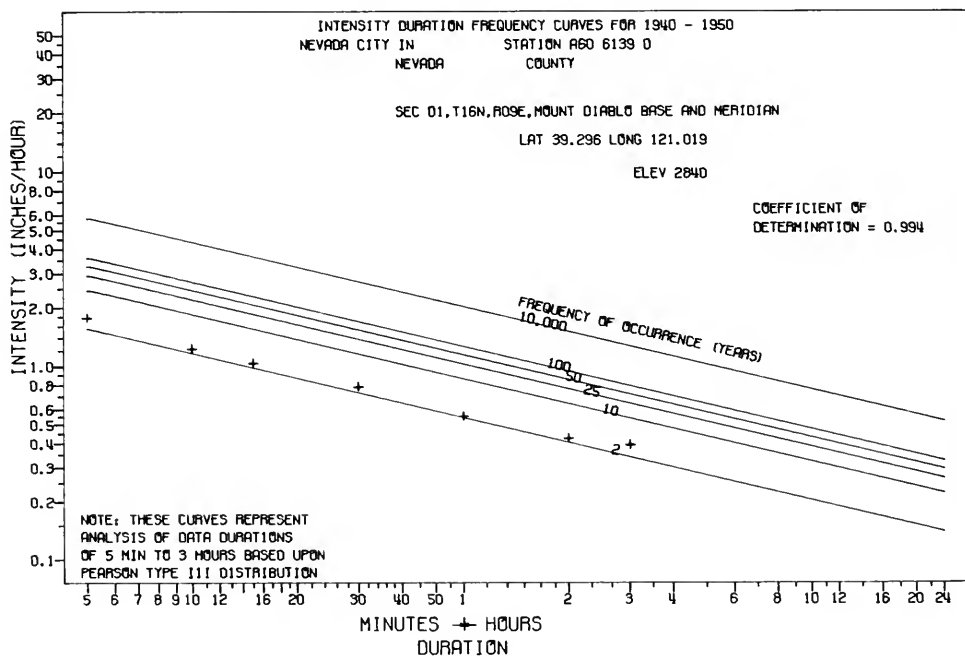
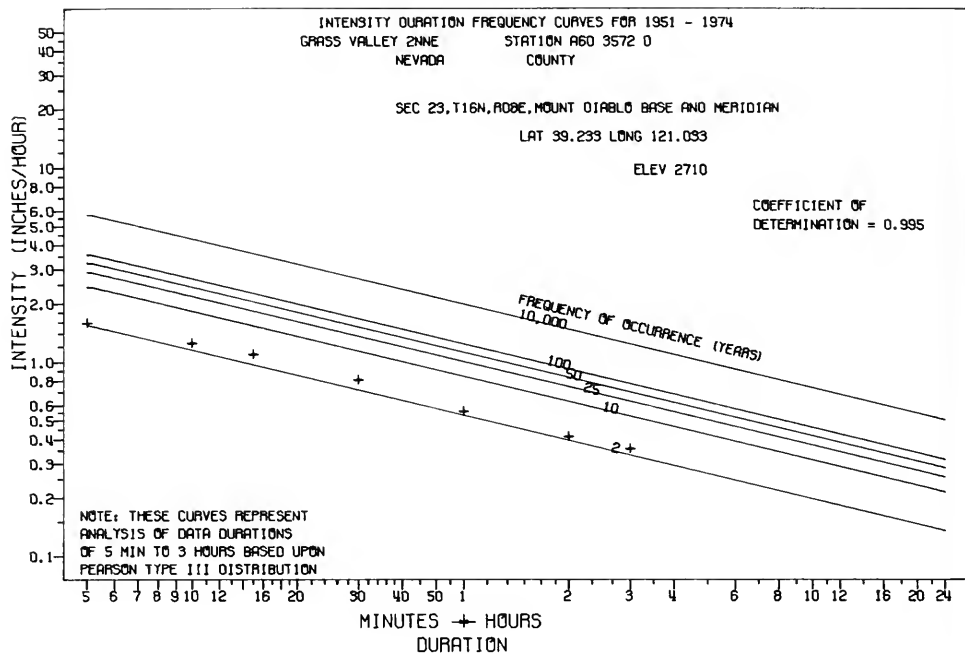


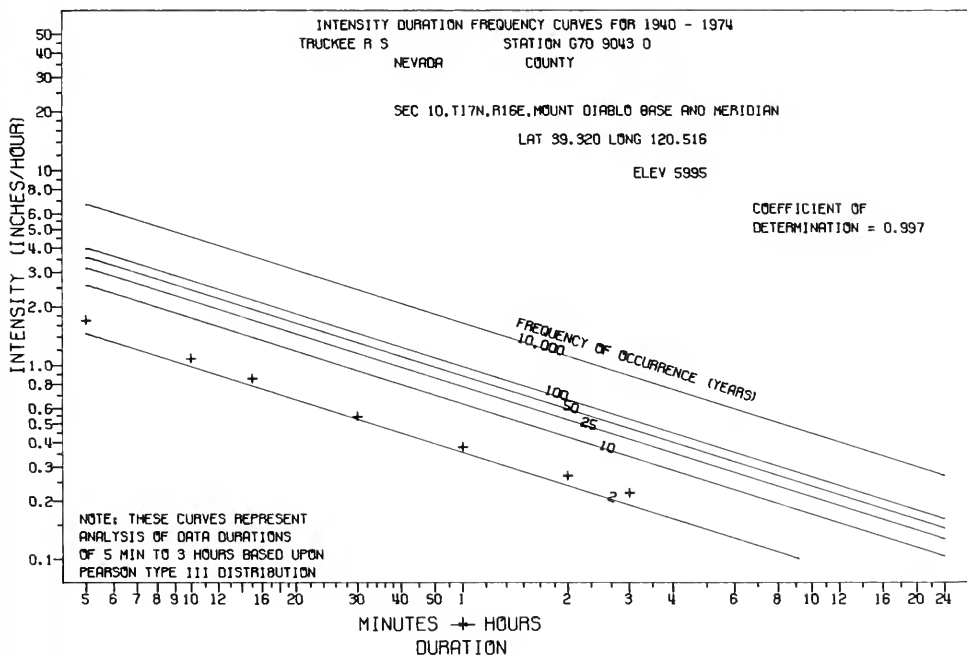
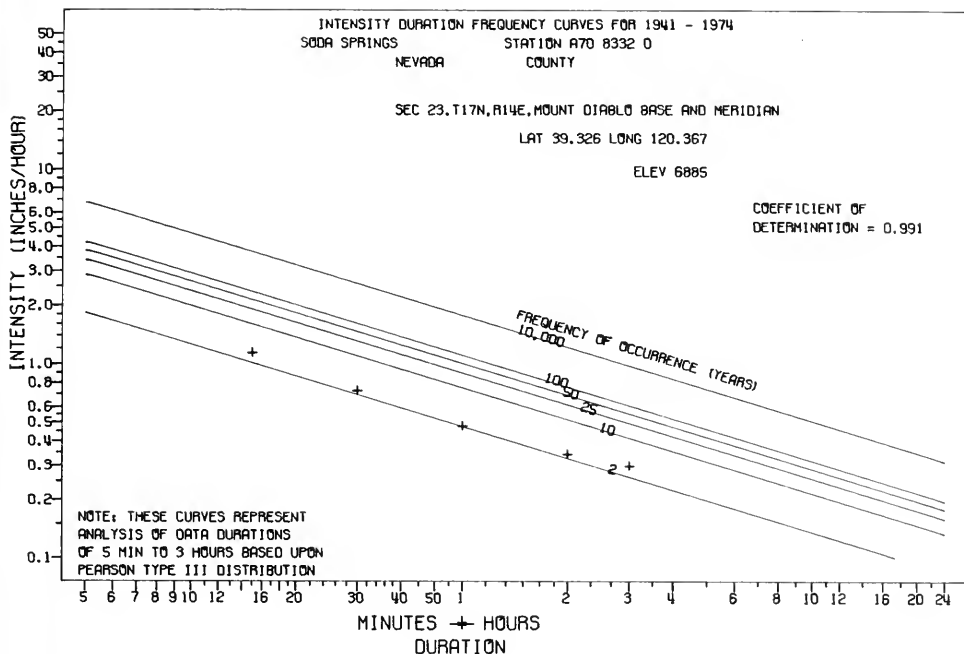


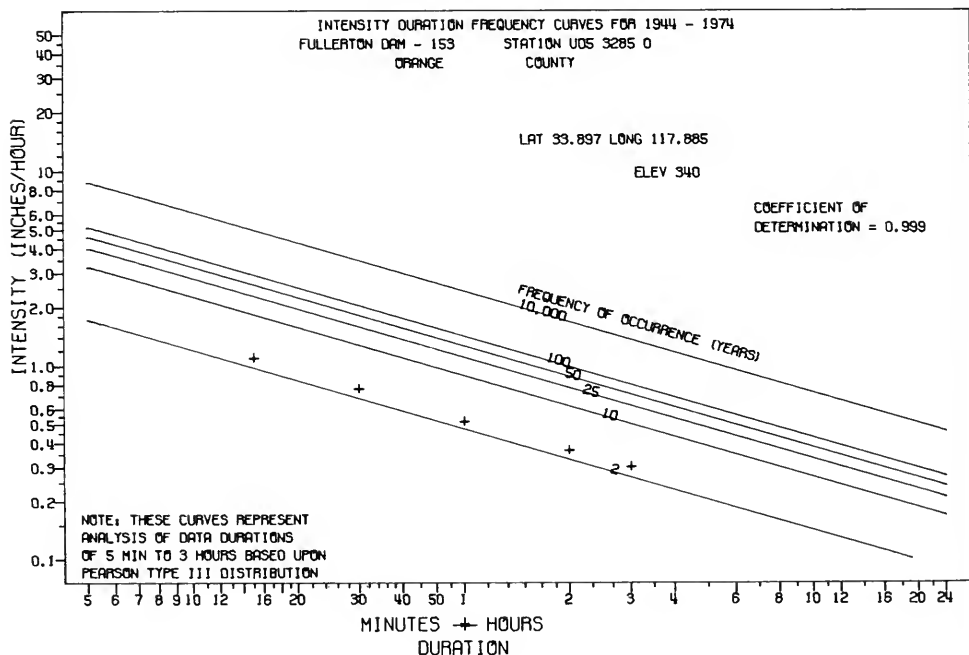
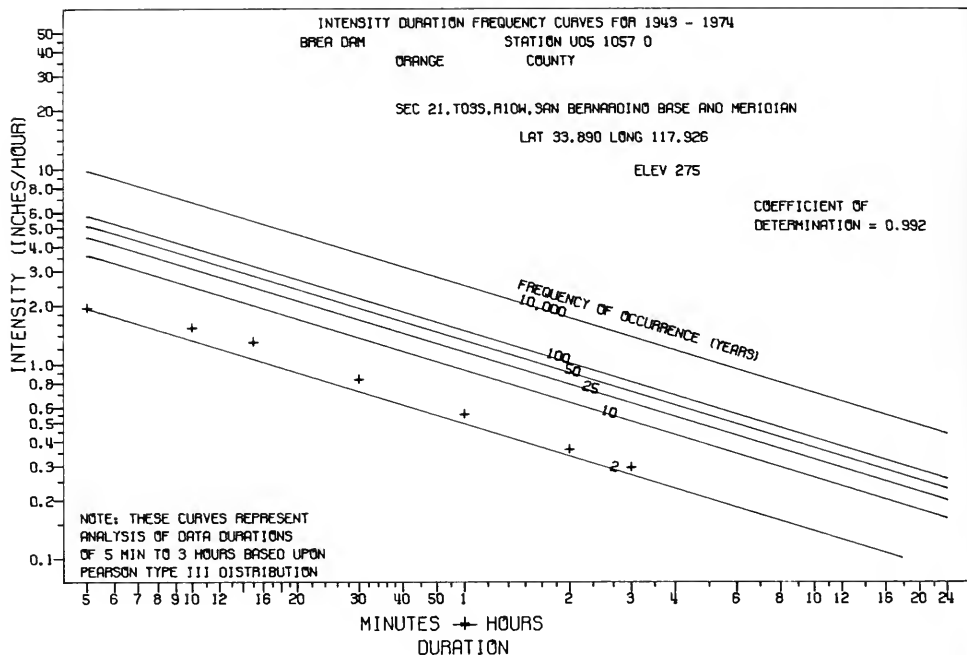


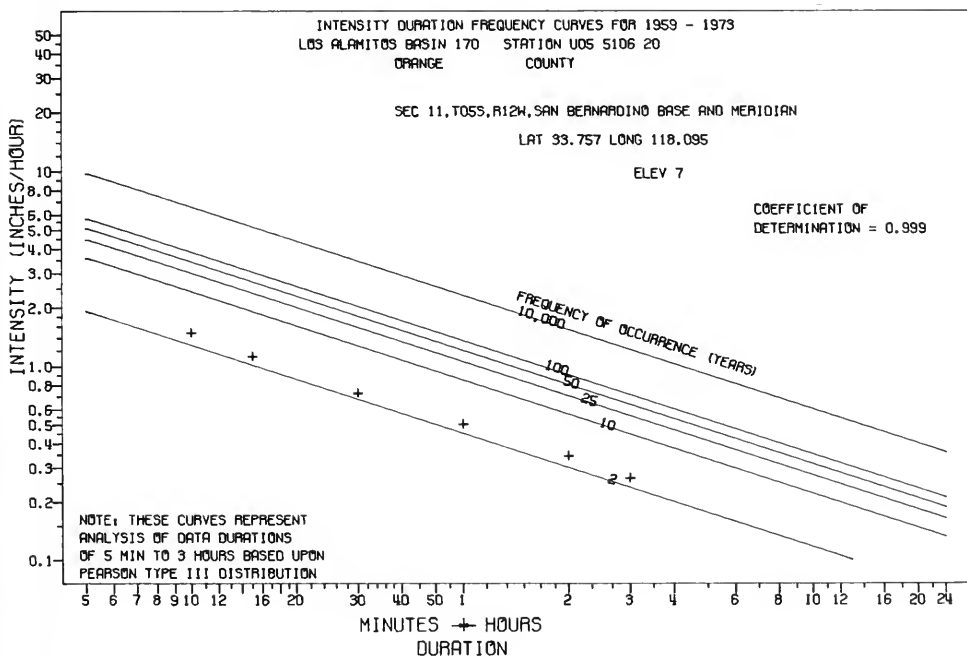
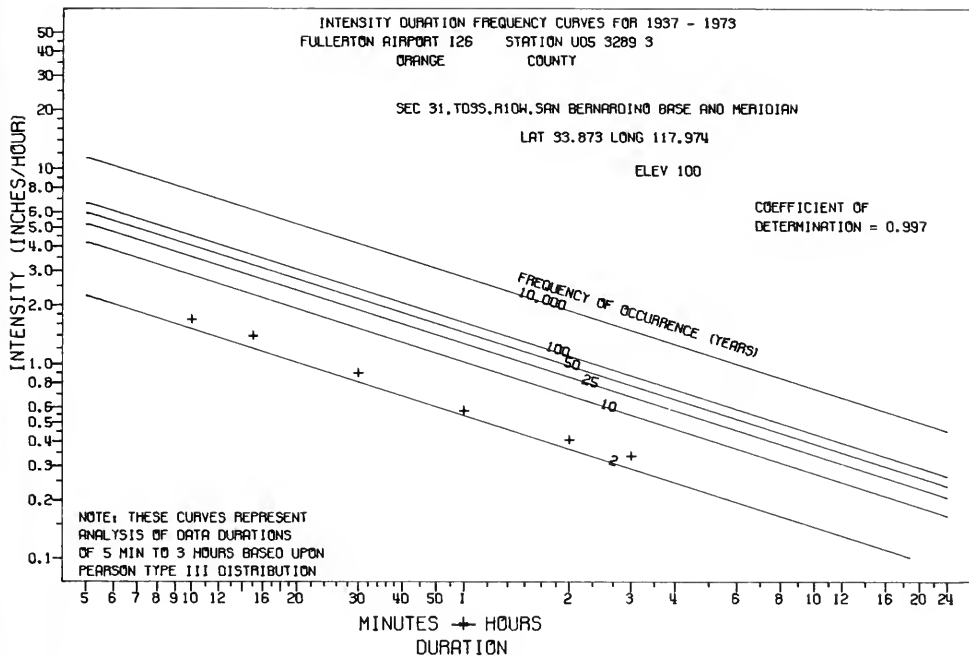


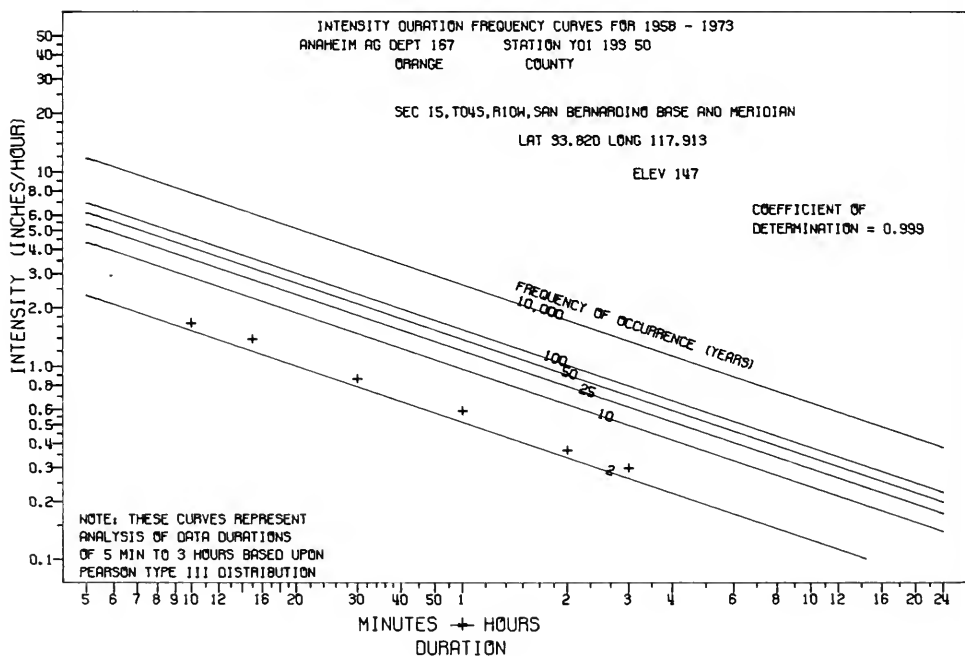
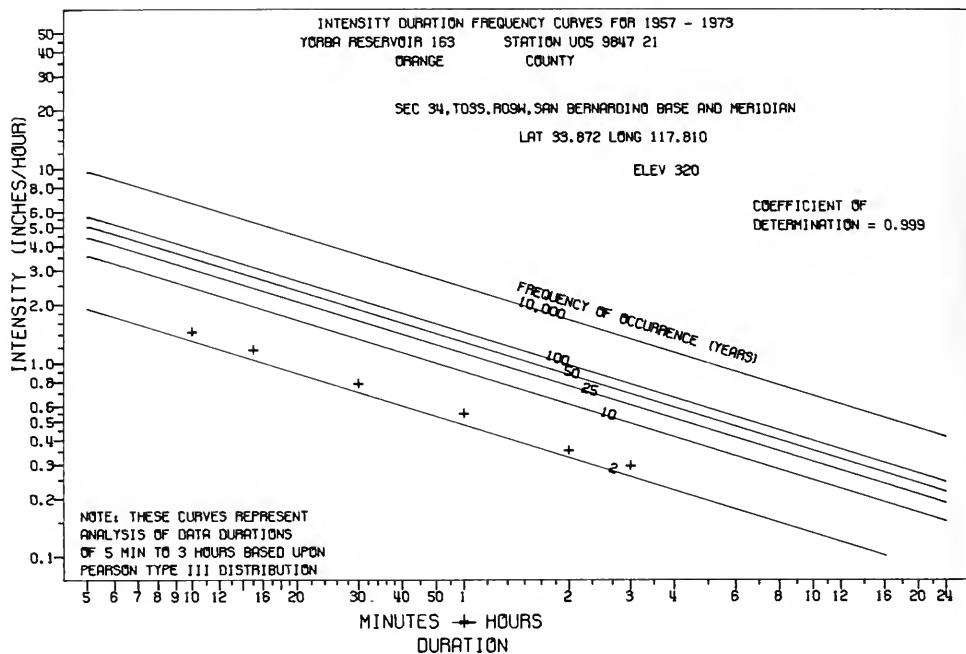


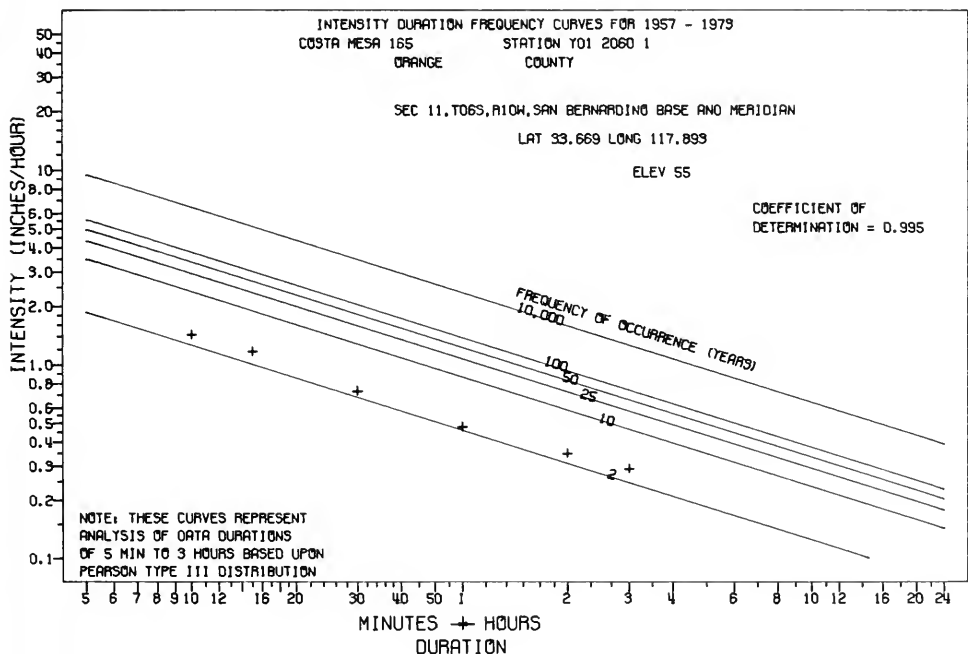
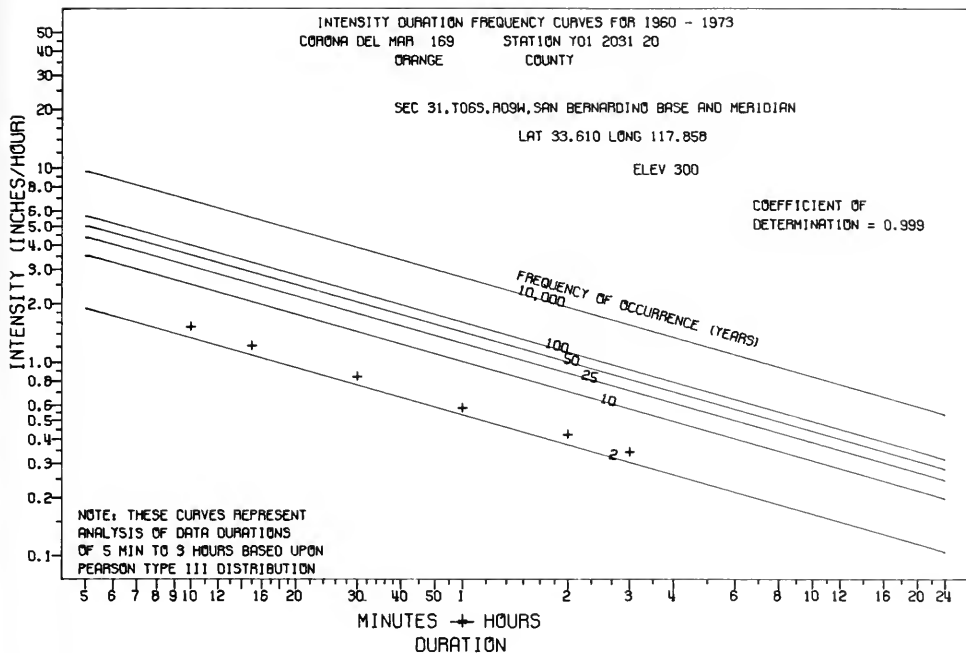


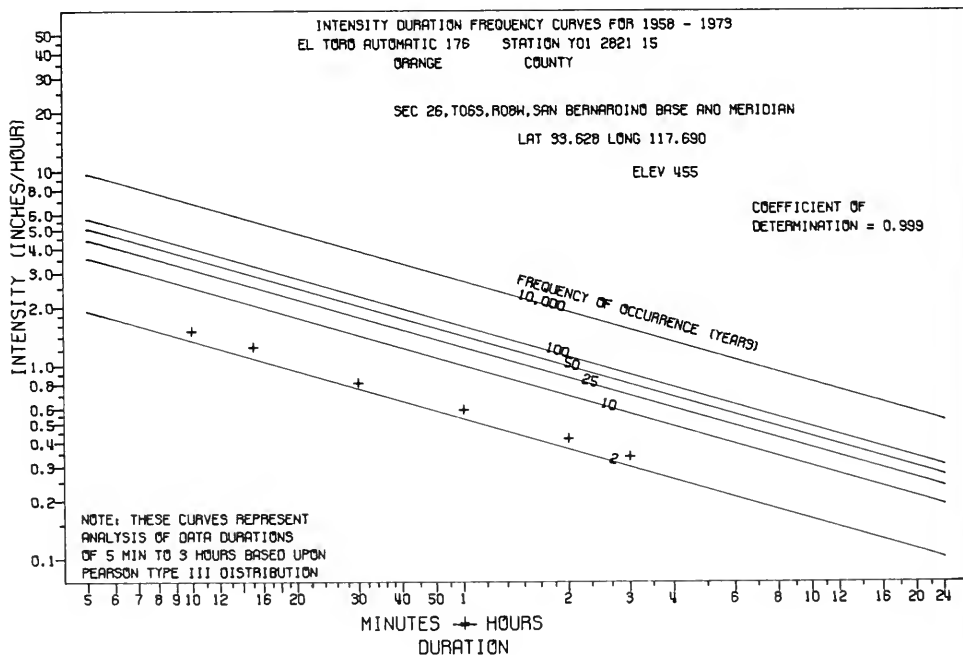
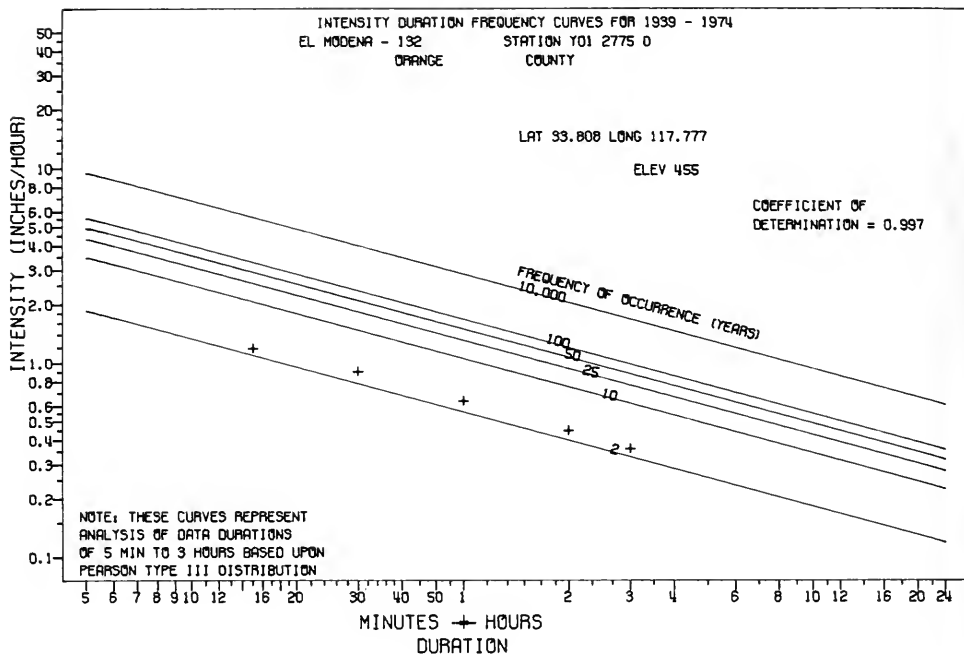


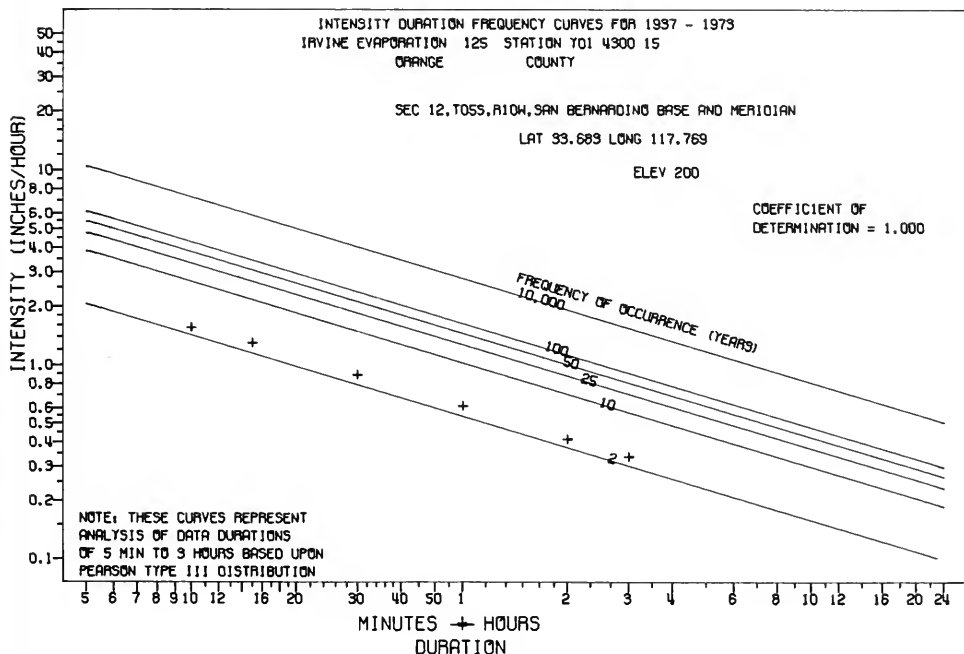
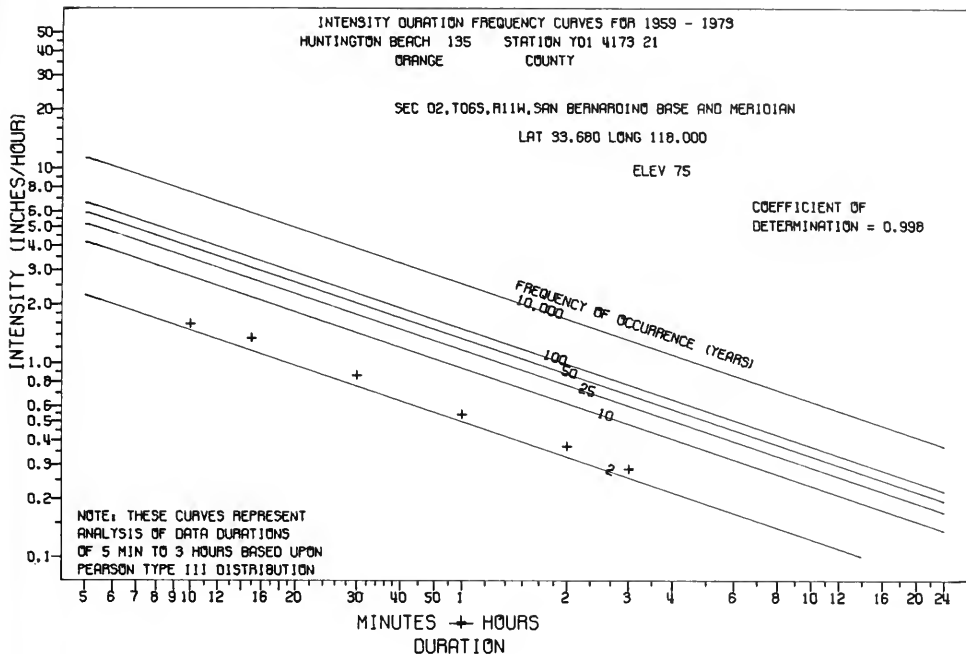


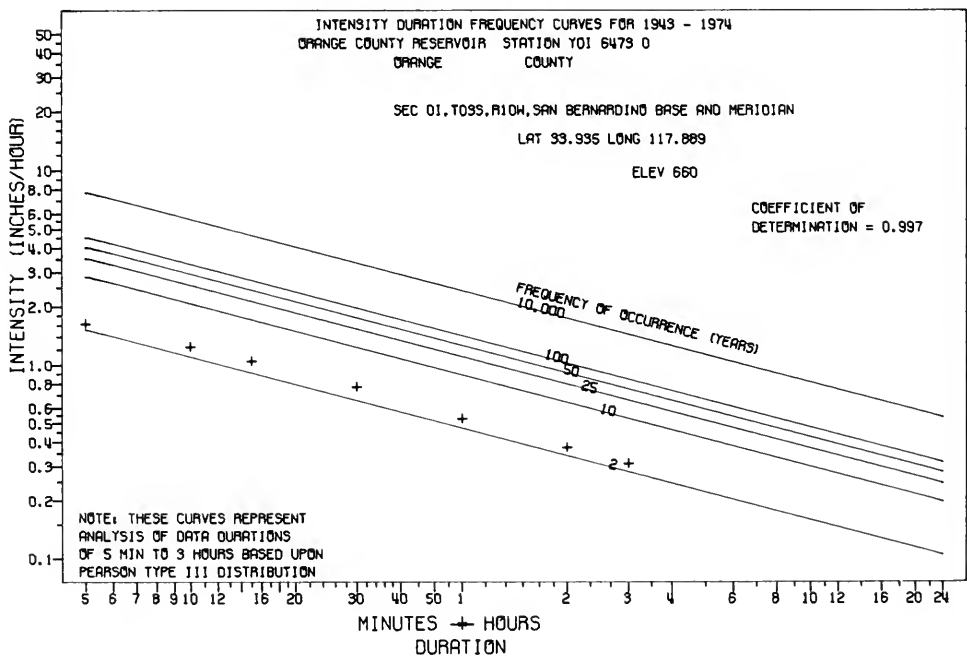
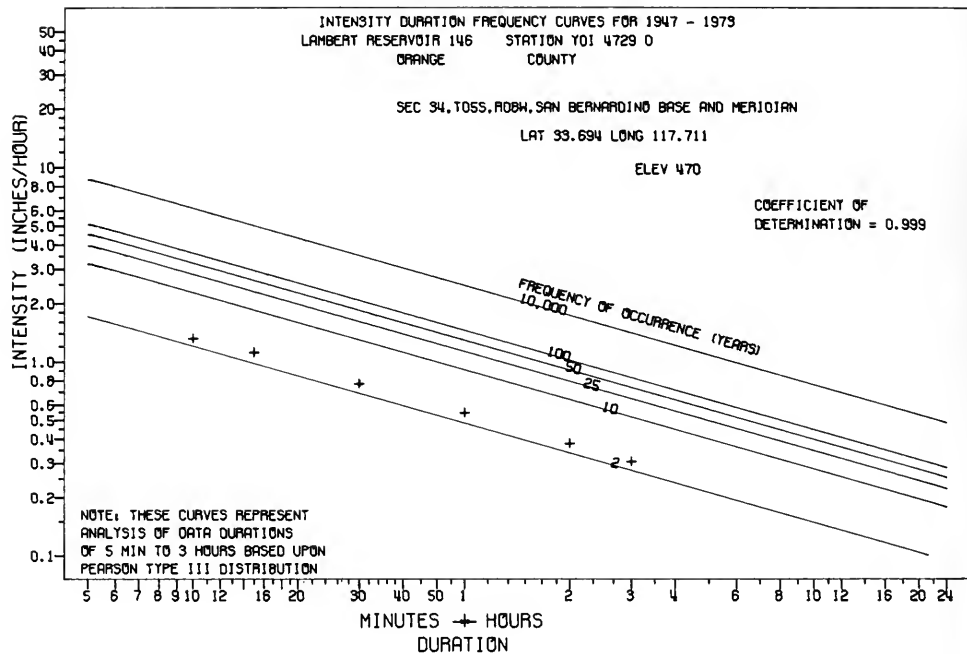


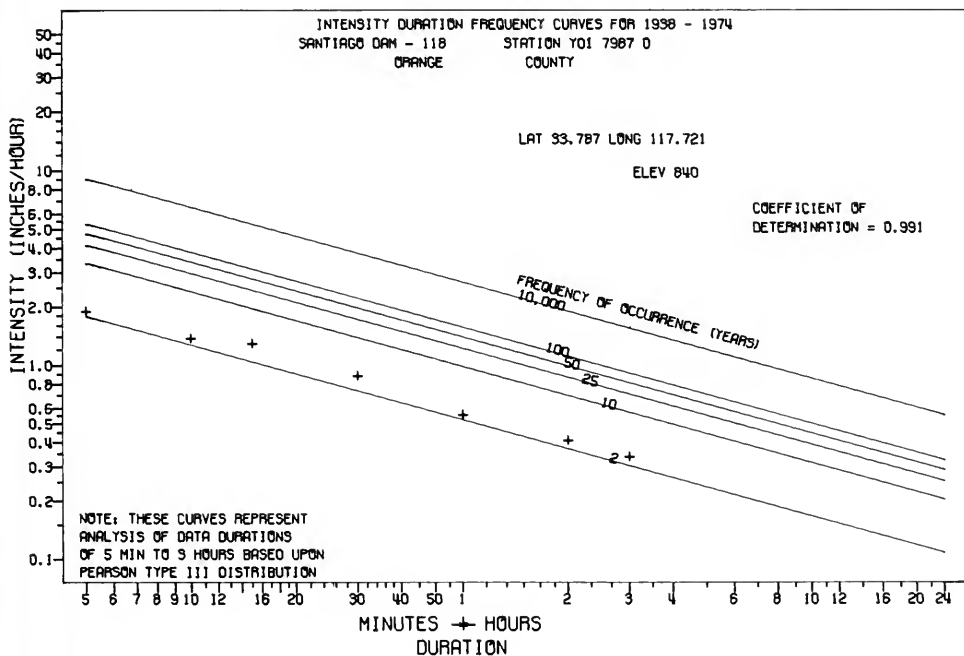
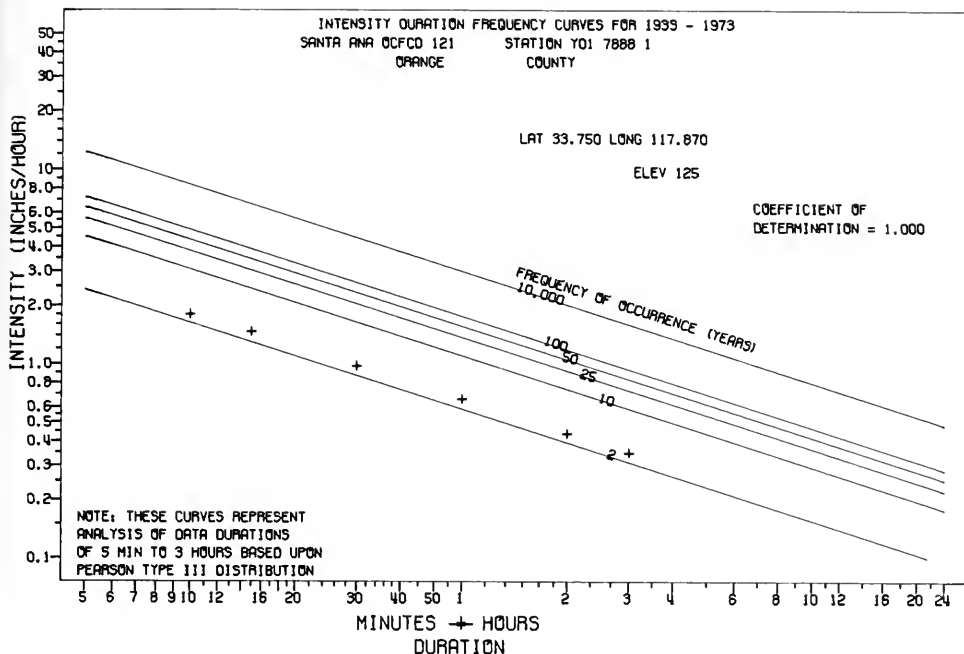


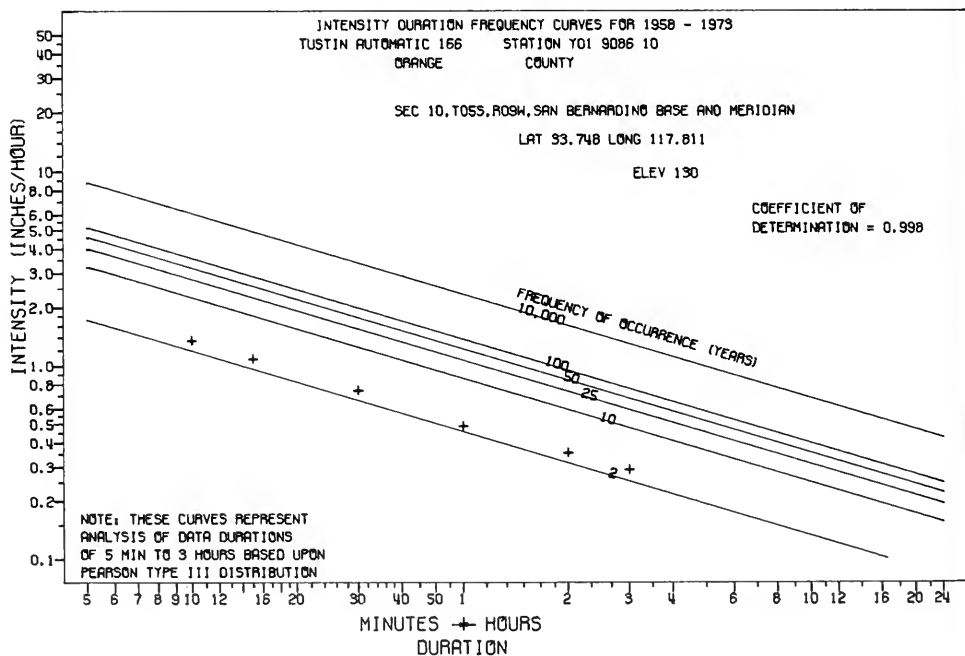
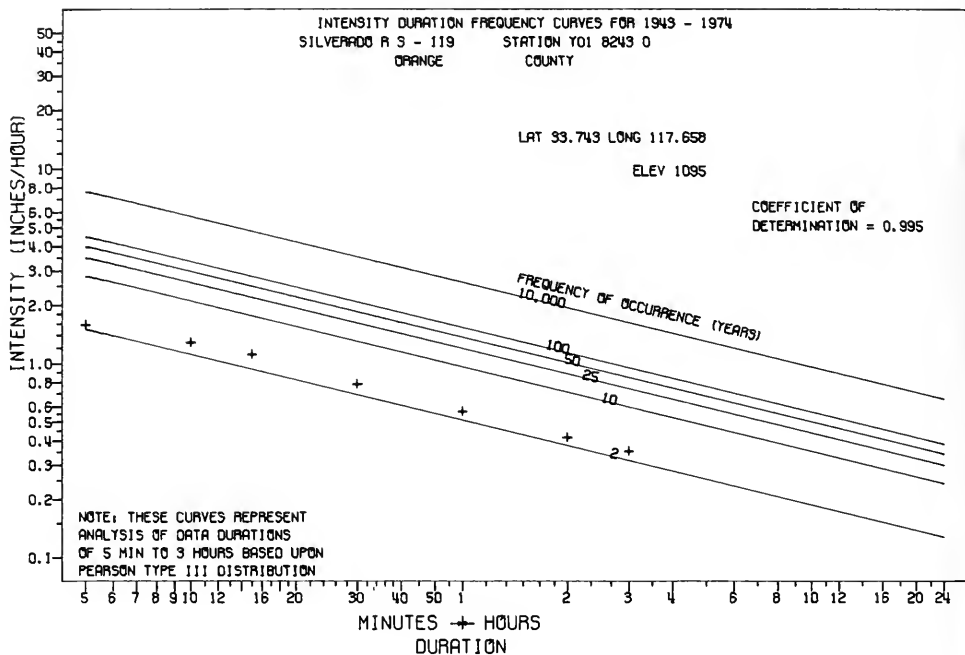


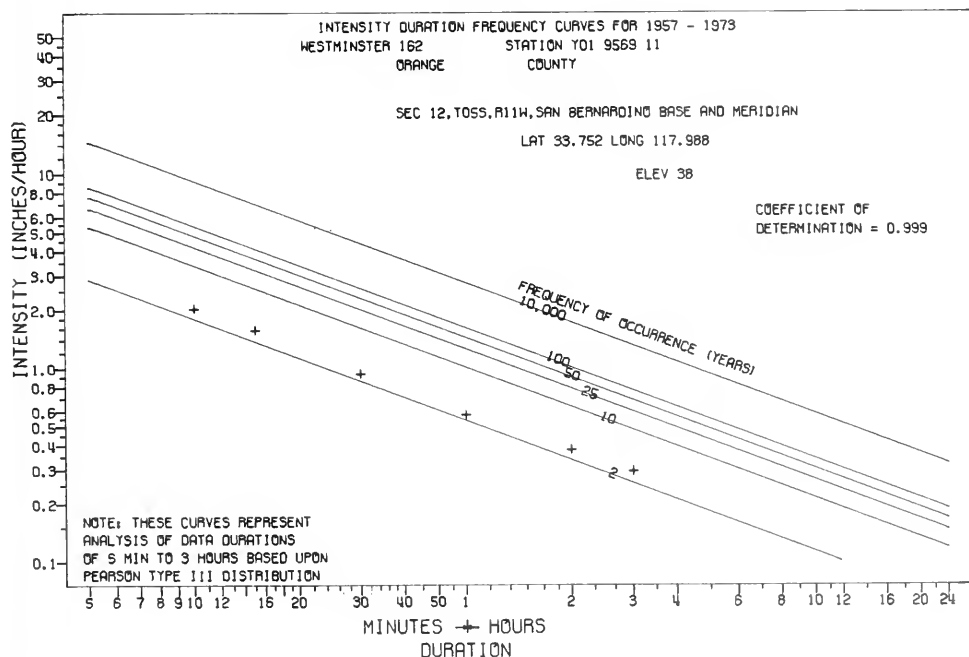
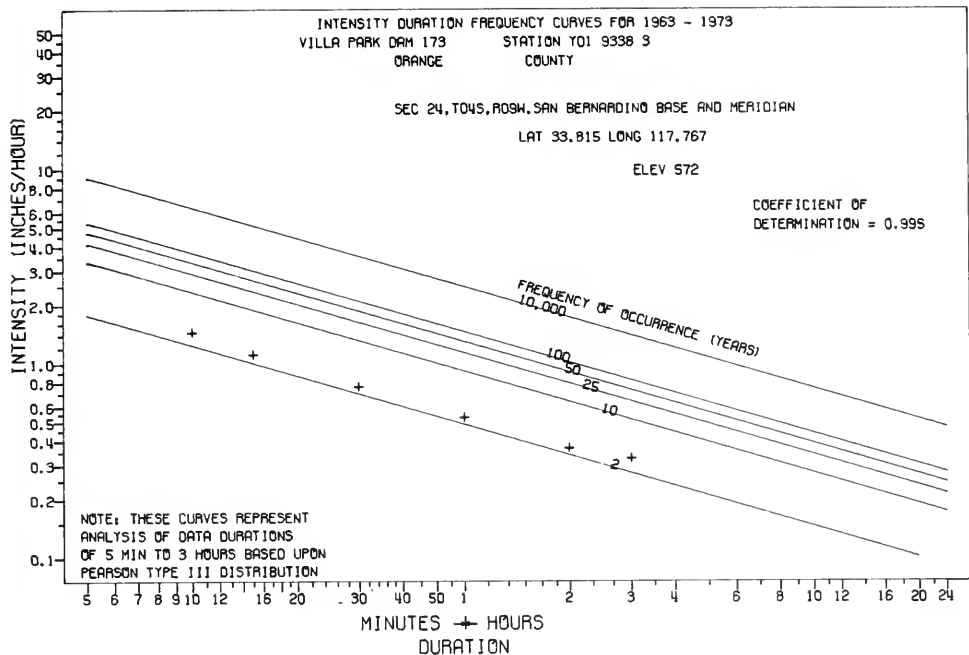


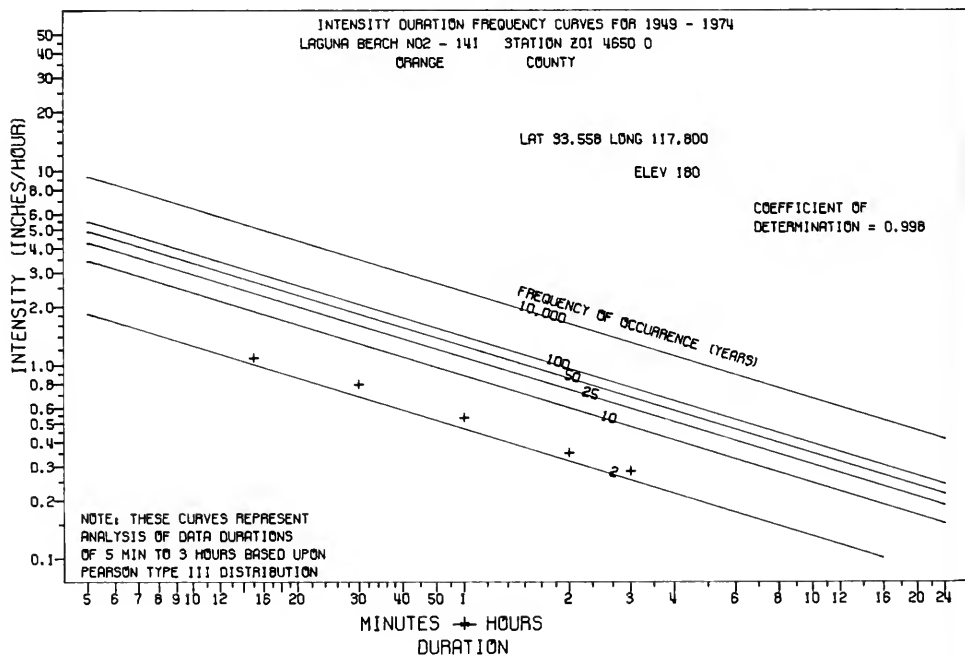
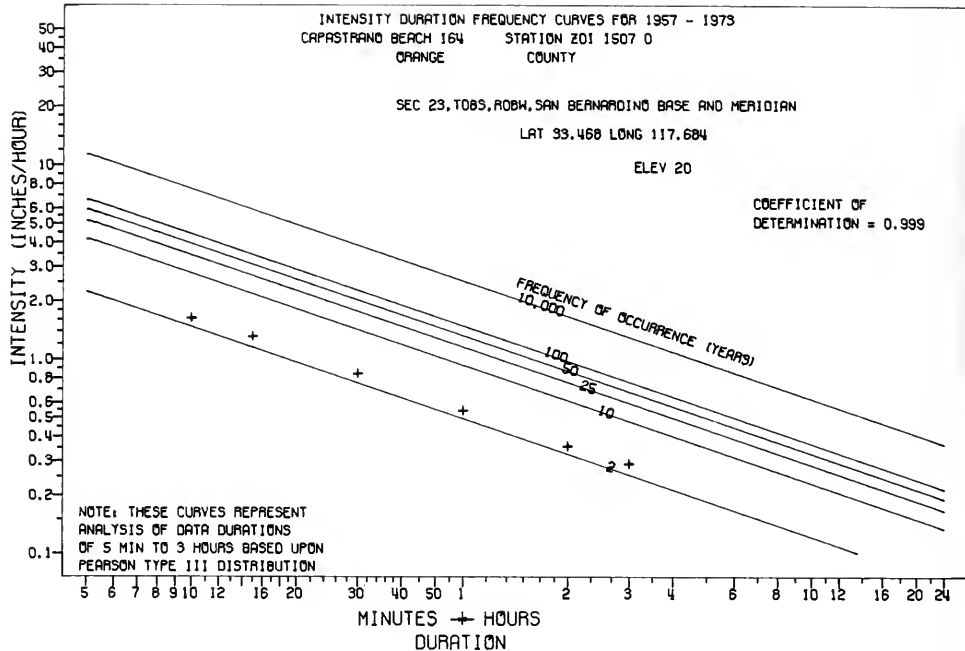












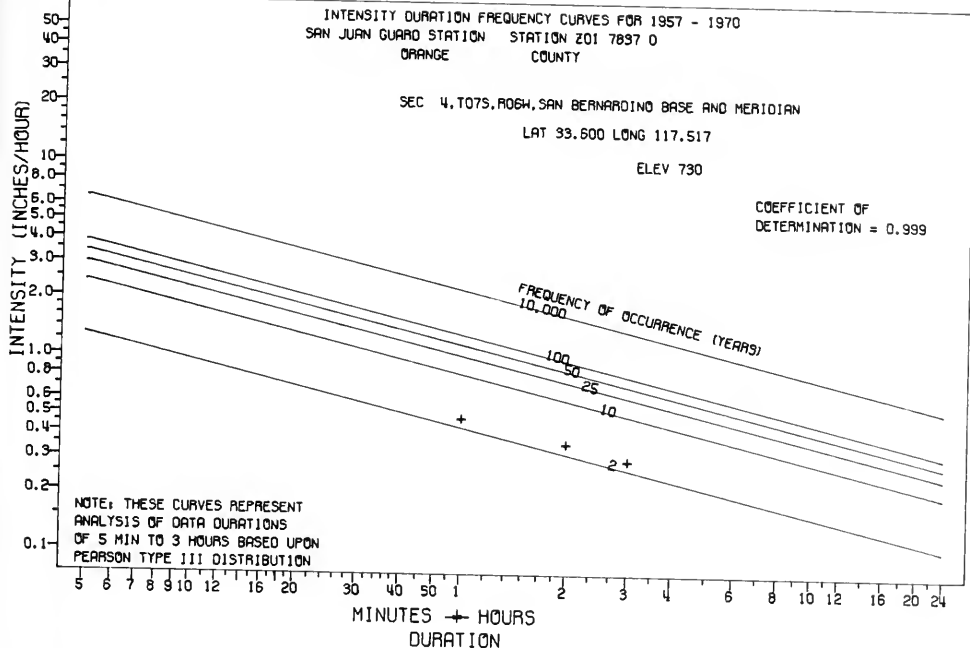
INTENSITY DURATION FREQUENCY CURVES FOR 1957 - 1970
 SAN JUAN GUARD STATION STATION 201 7897 0
 ORANGE COUNTY

SEC 4, T07S, R06W, SAN BERNARDINO BASE AND MERIDIAN

LAT 33.600 LONG 117.517

ELEV 730

COEFFICIENT OF
 DETERMINATION = 0.999

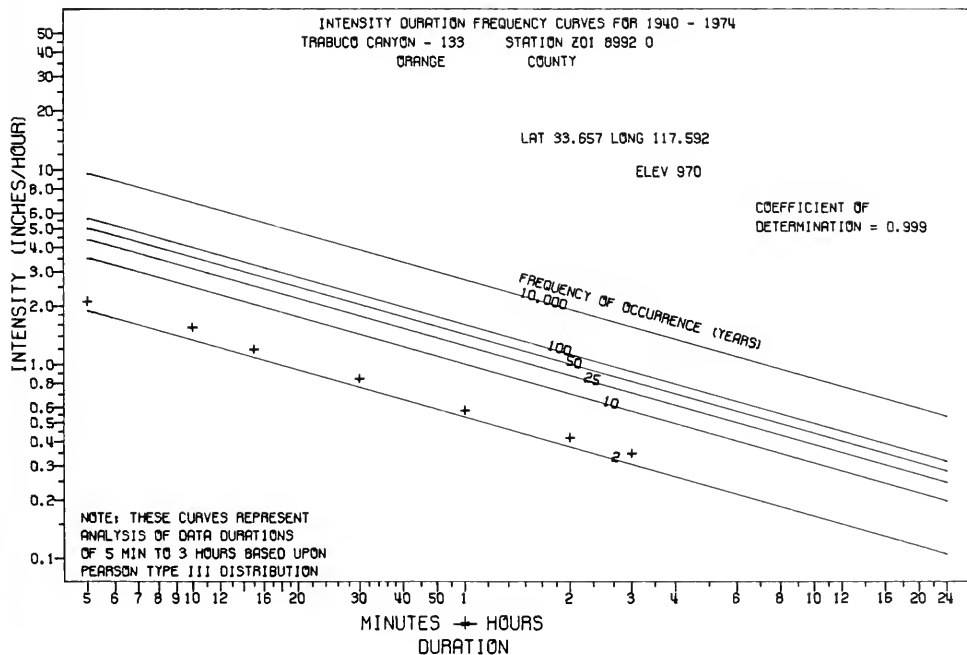


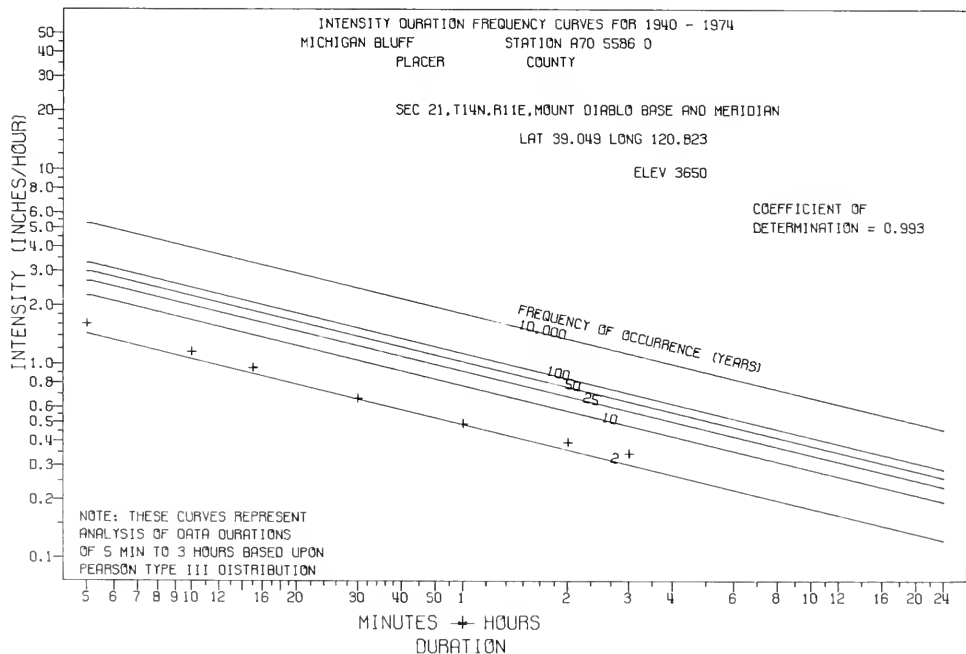
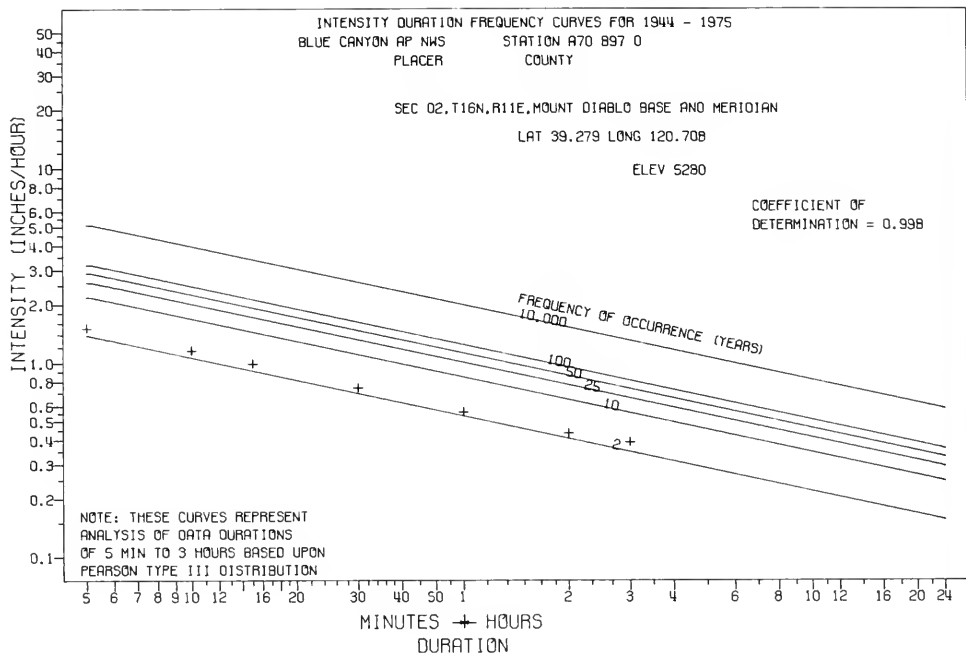
INTENSITY DURATION FREQUENCY CURVES FOR 1940 - 1974
 TRABUCO CANYON - 133 STATION 201 8992 0
 ORANGE COUNTY

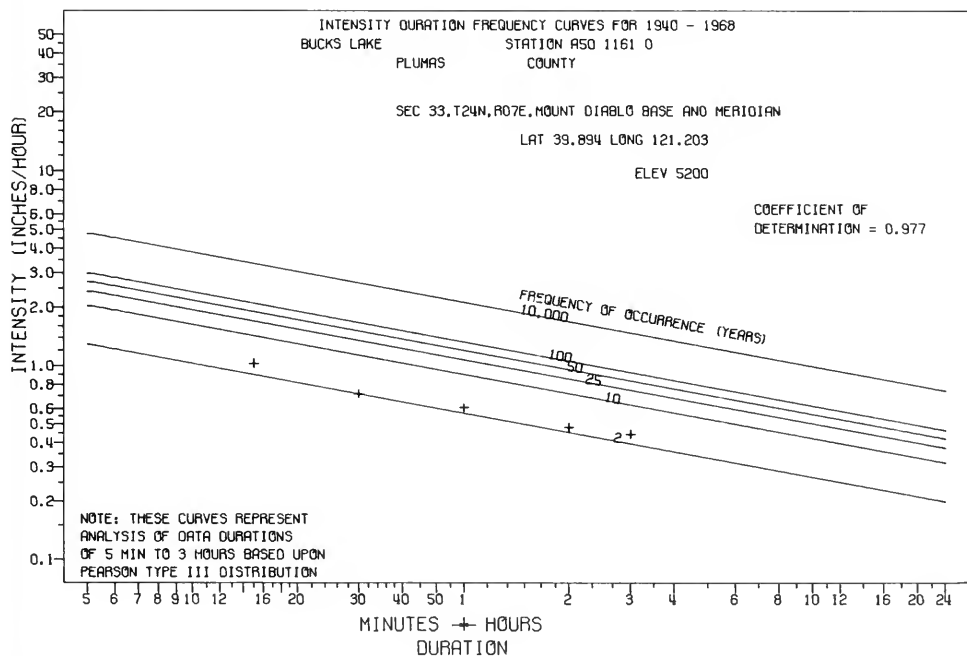
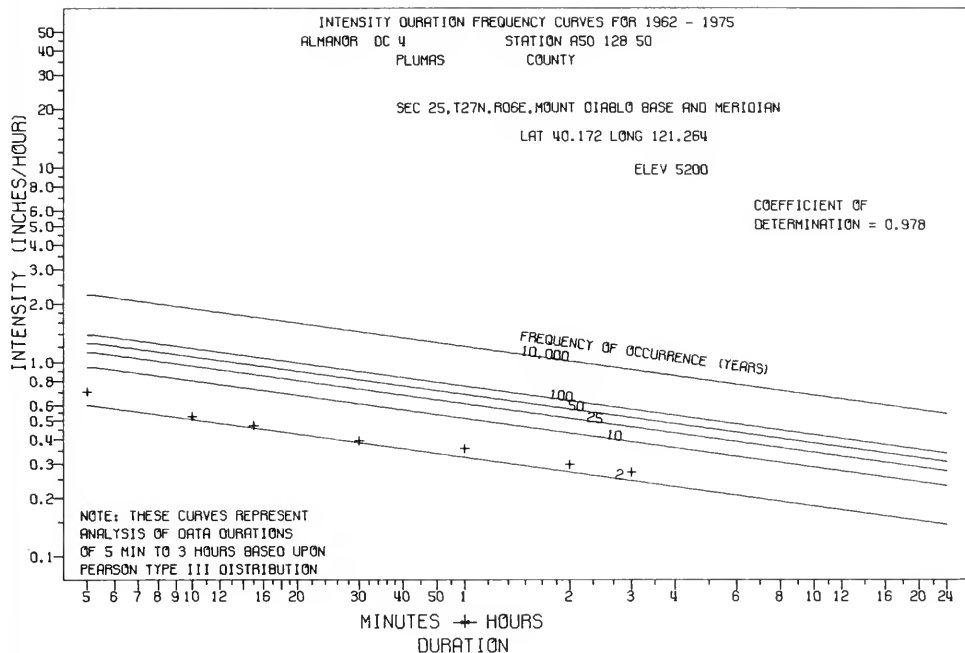
LAT 33.657 LONG 117.592

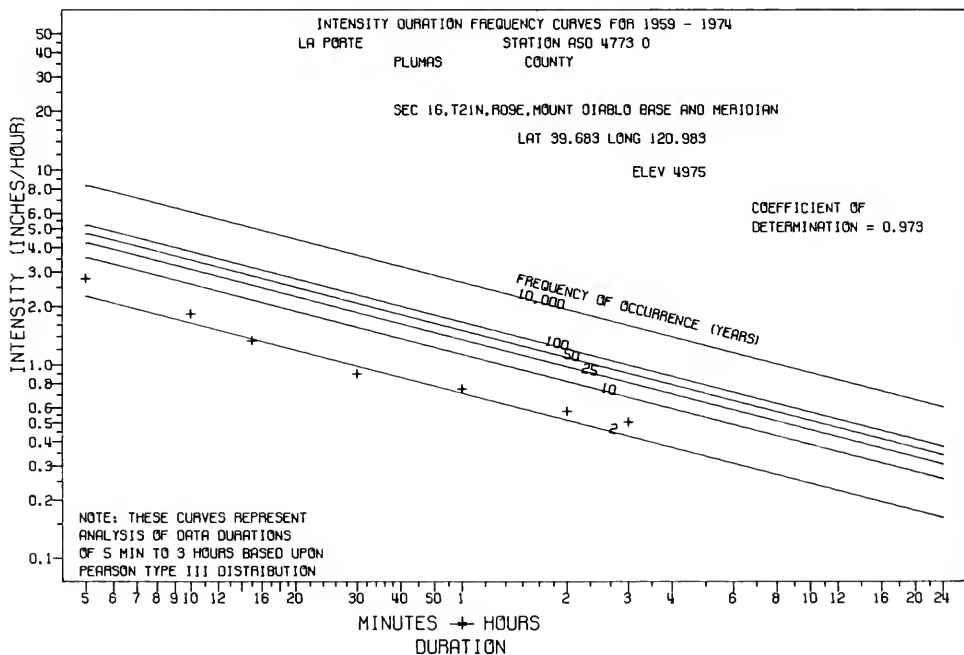
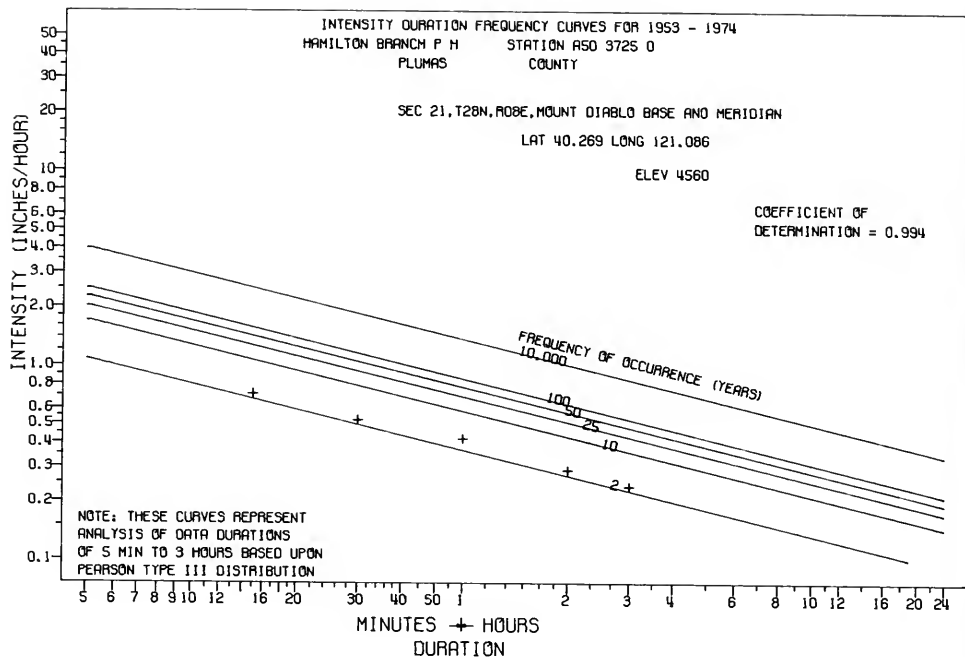
ELEV 970

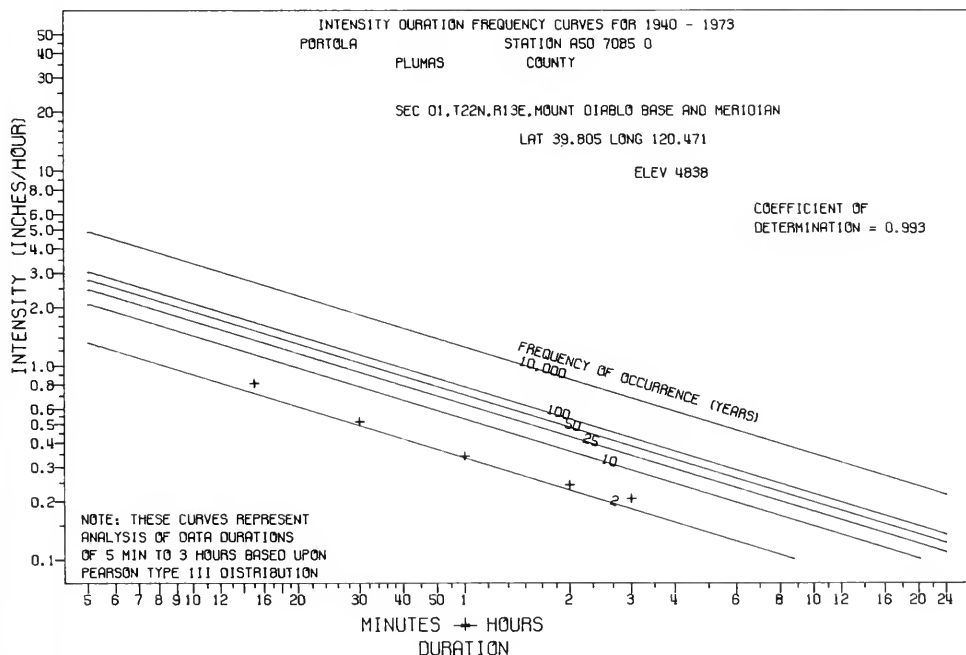
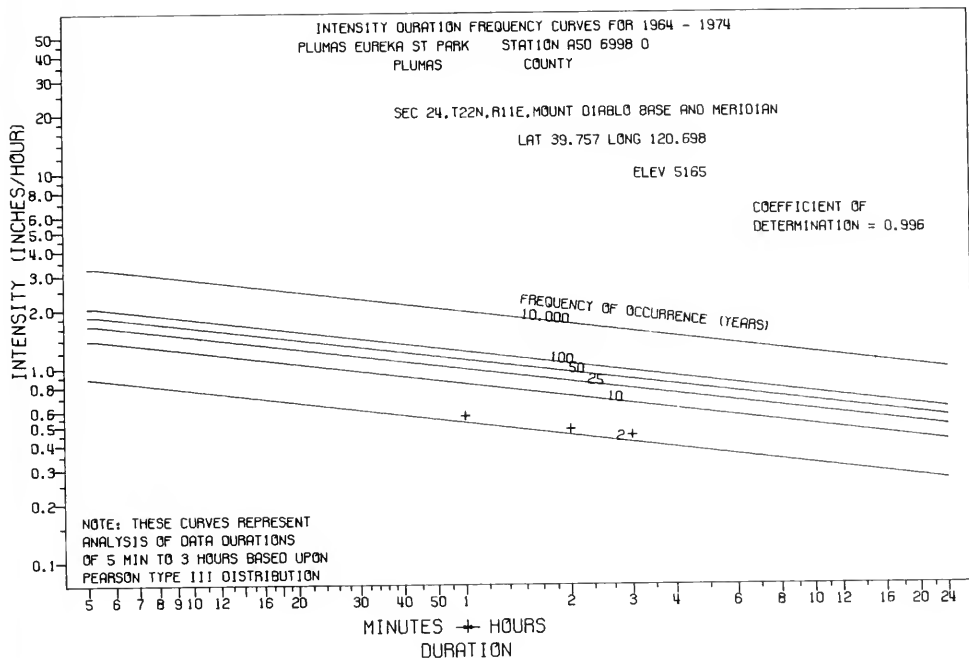
COEFFICIENT OF
 DETERMINATION = 0.999

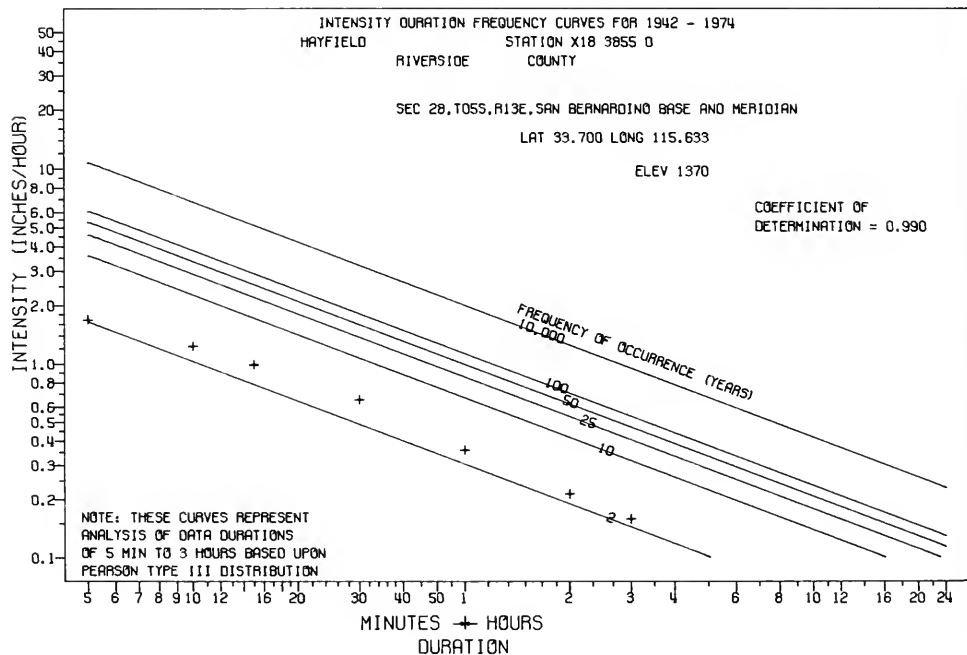
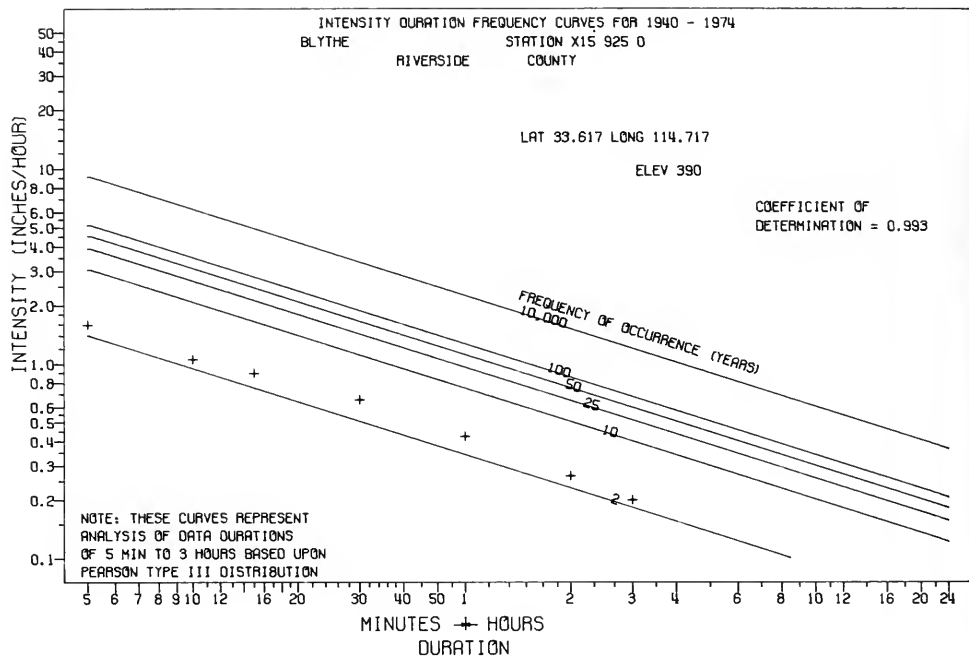












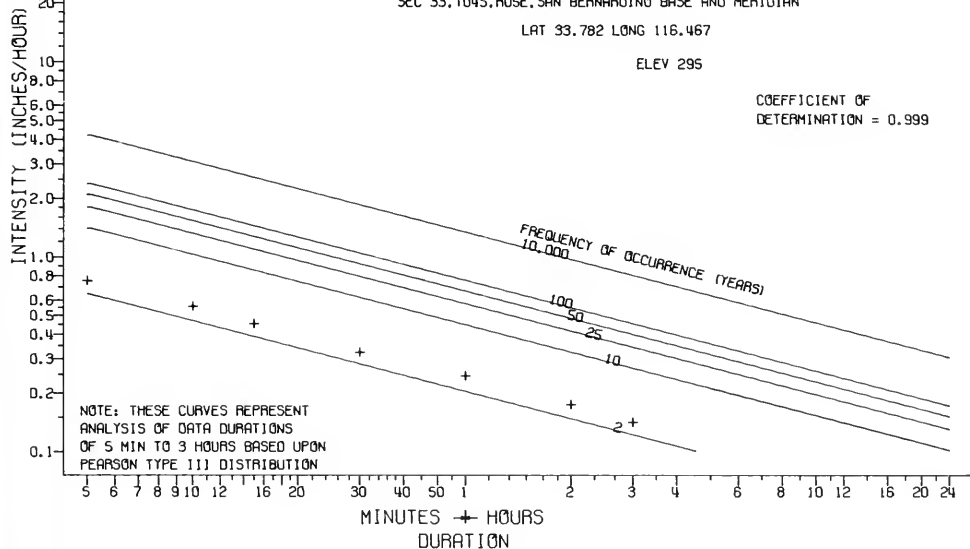
INTENSITY DURATION FREQUENCY CURVES FOR 1969 - 1975
 CATHEDRAL CITY A D STATION X19 1594 0
 RIVERSIDE COUNTY

SEC 33, T04S, R05E, SAN BERNARDINO BASE AND MERIDIAN

LAT 33.782 LONG 116.467

ELEV 295

COEFFICIENT OF
 DETERMINATION = 0.999



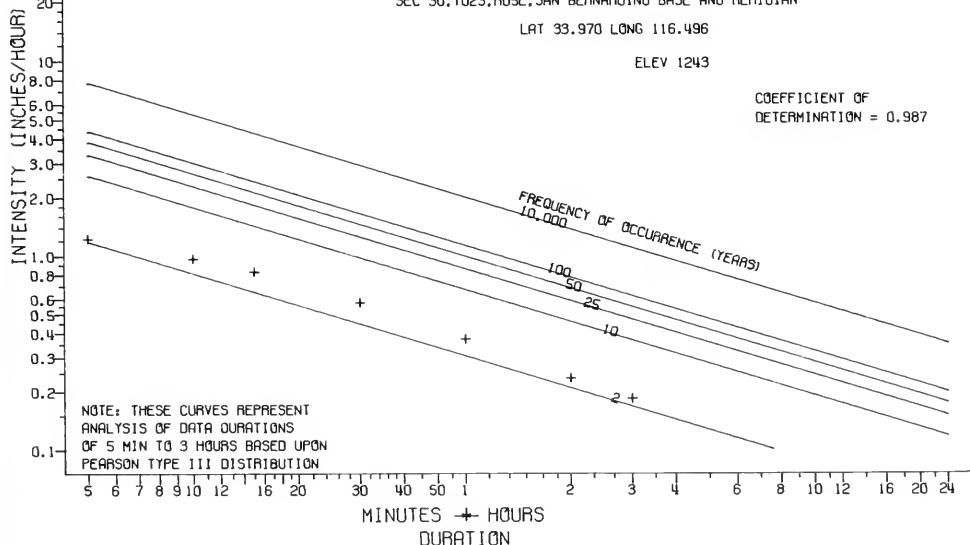
INTENSITY DURATION FREQUENCY CURVES FOR 1958 - 1975
 DESERT HOT SPRINGS STATION X19 2405 0
 RIVERSIDE COUNTY

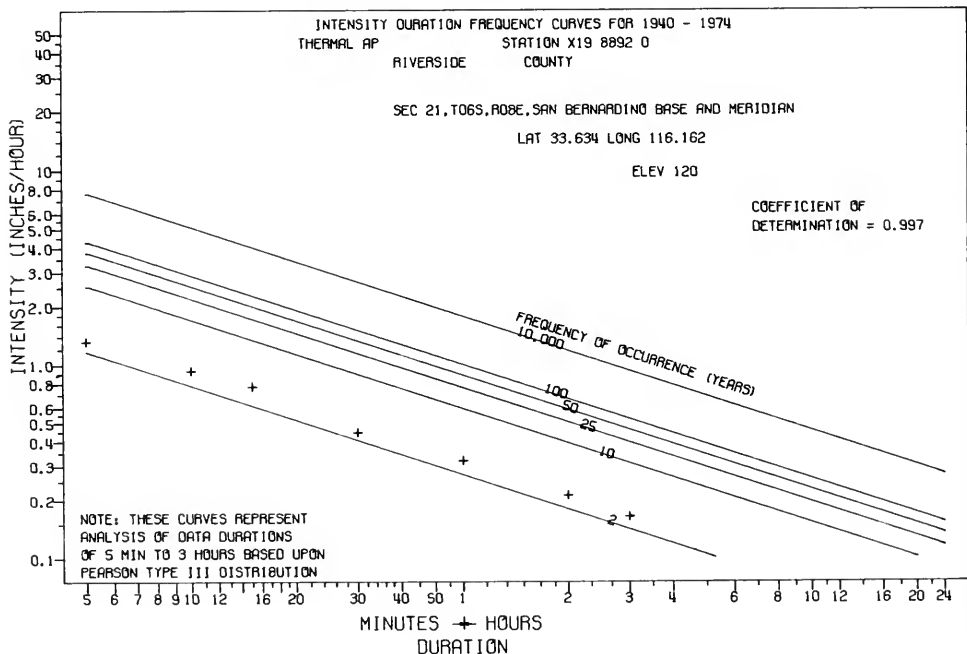
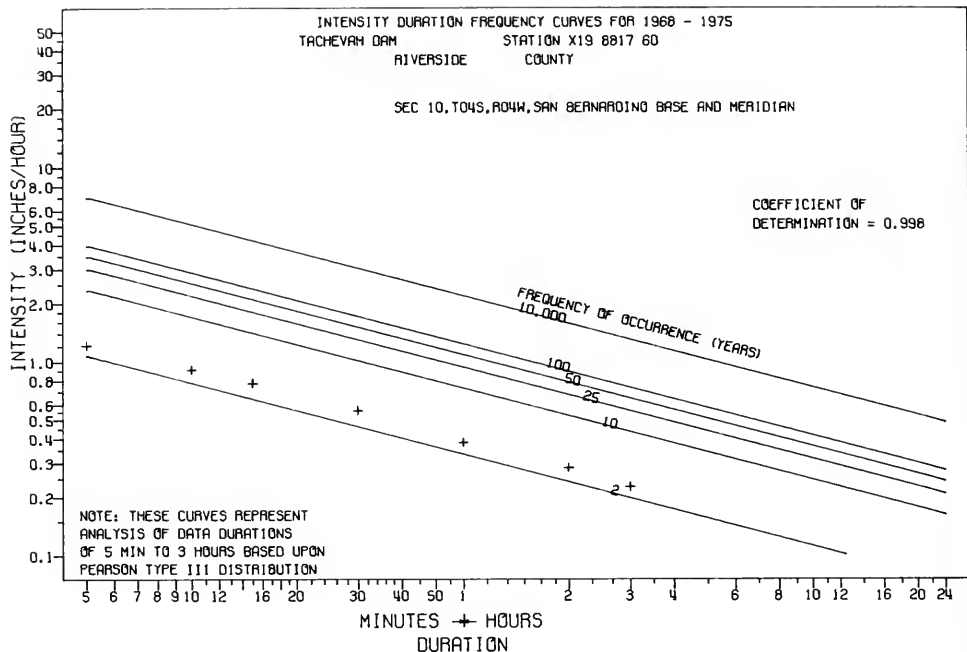
SEC 30, T02S, R05E, SAN BERNARDINO BASE AND MERIDIAN

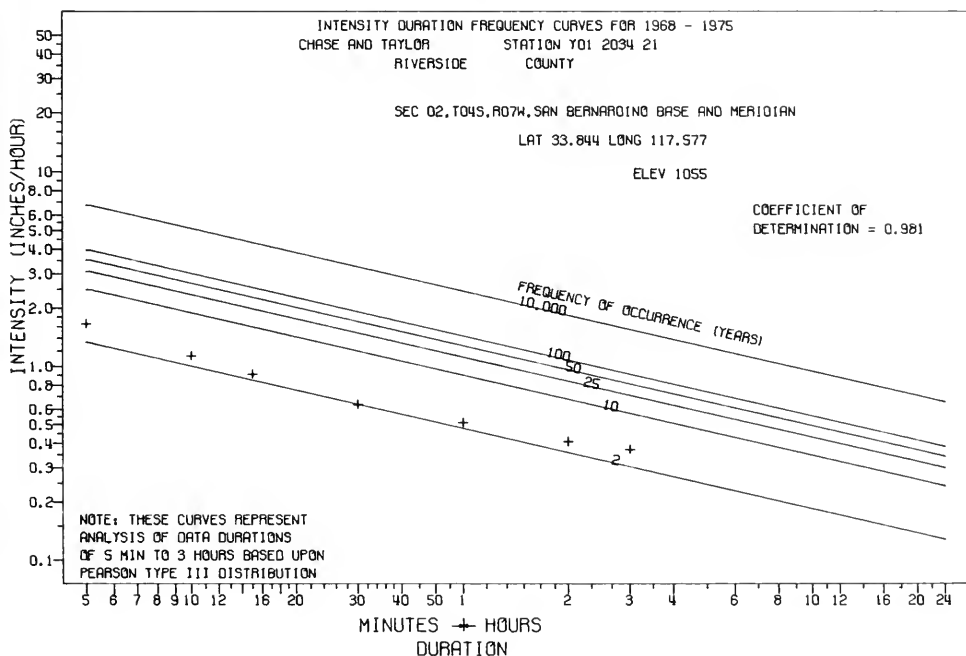
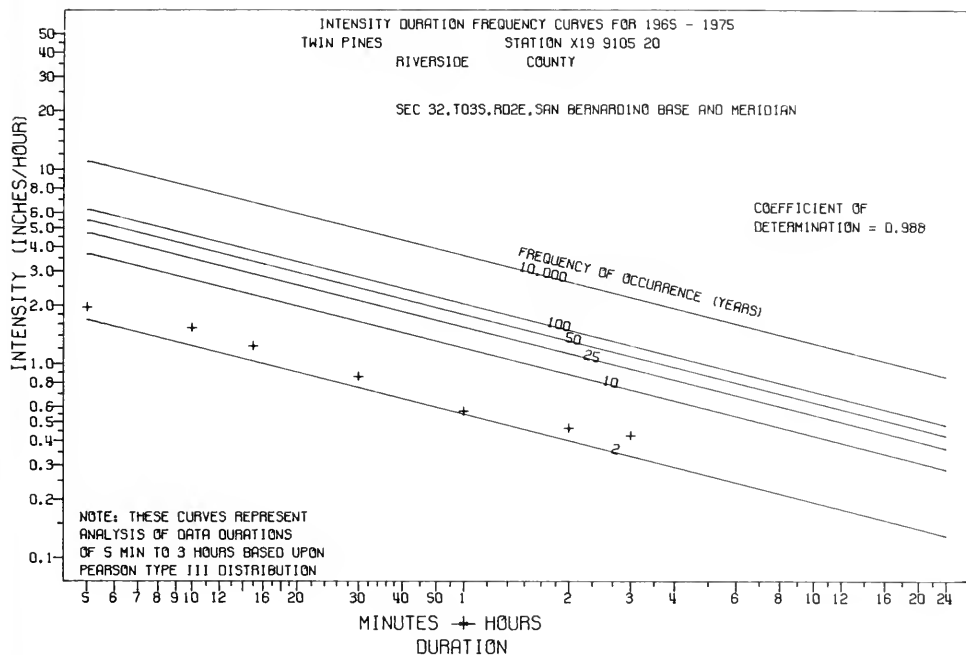
LAT 33.970 LONG 116.496

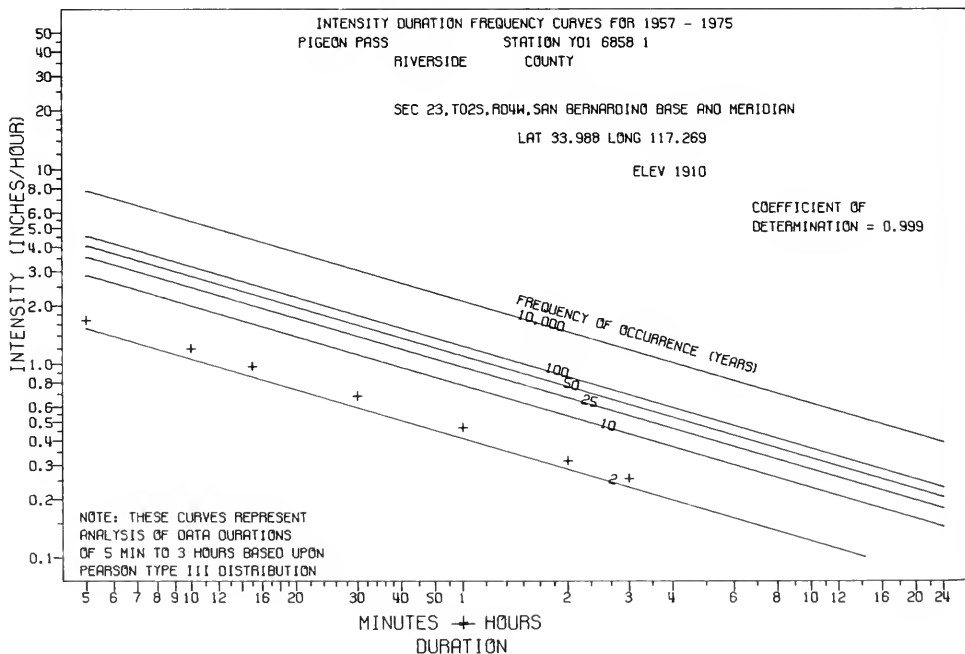
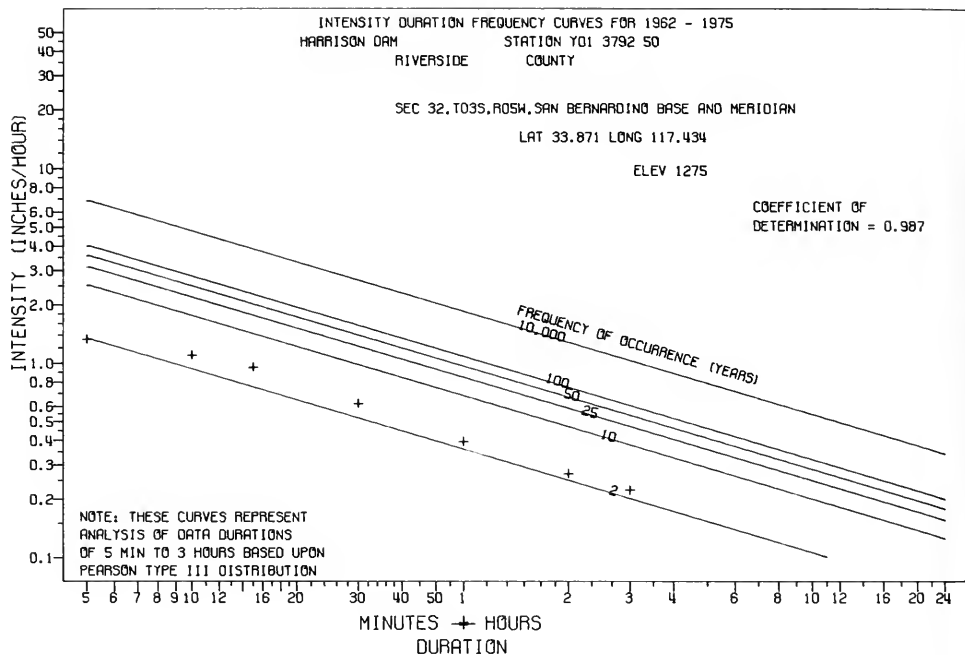
ELEV 1243

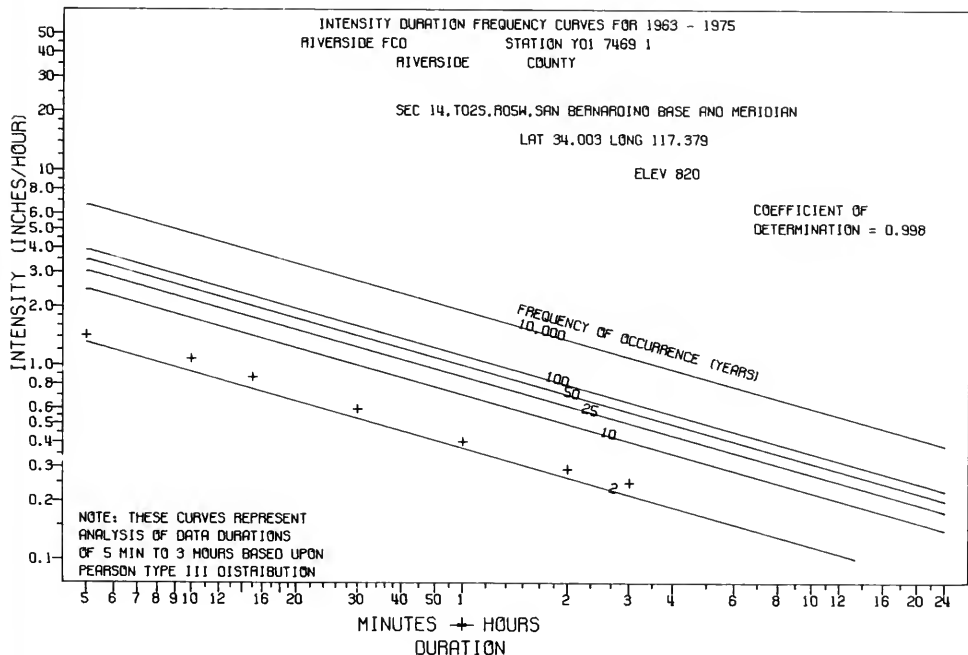
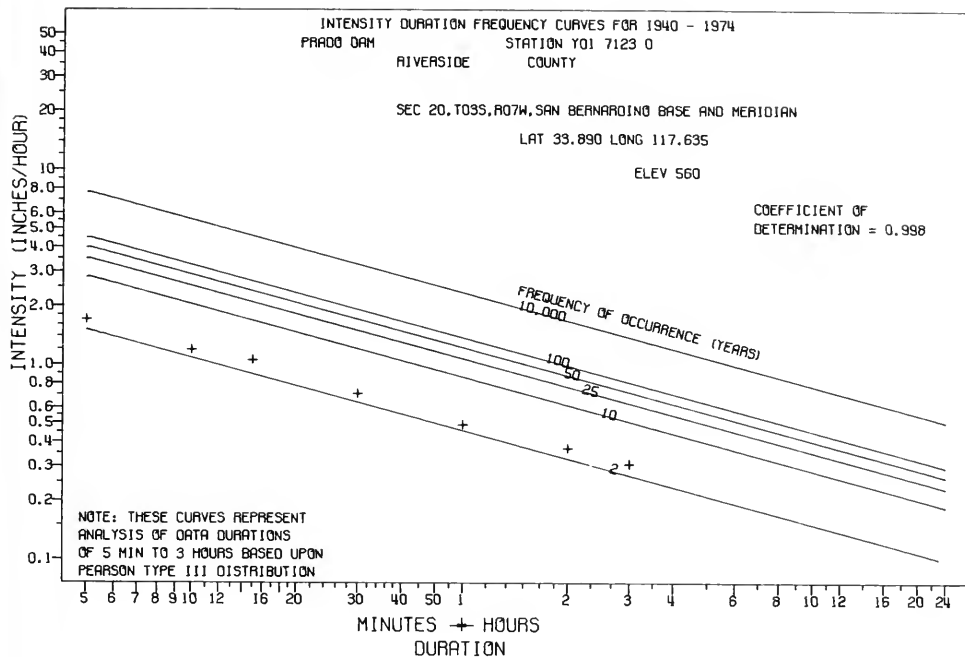
COEFFICIENT OF
 DETERMINATION = 0.987

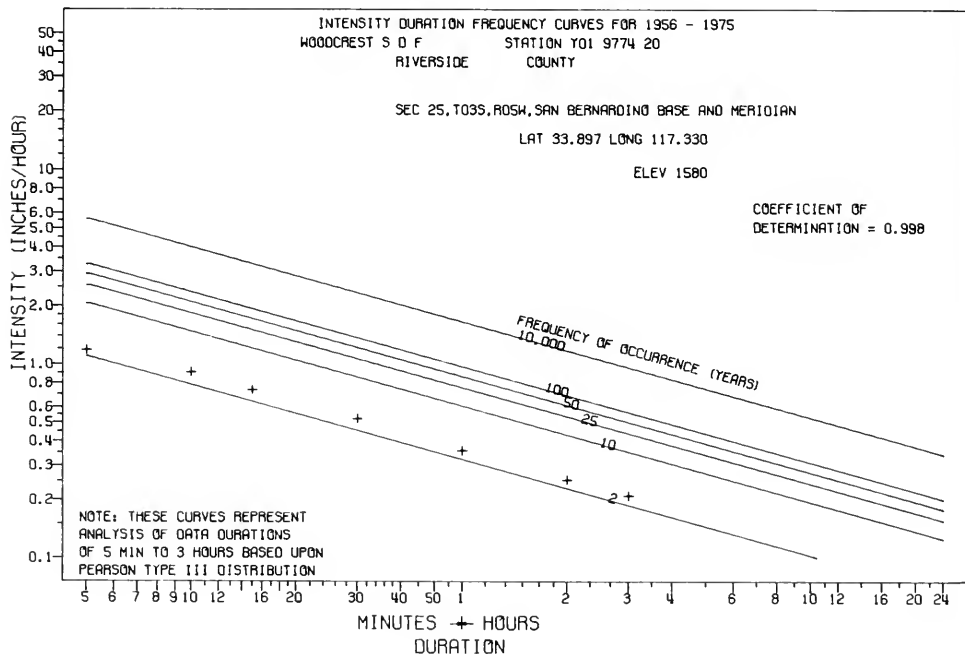
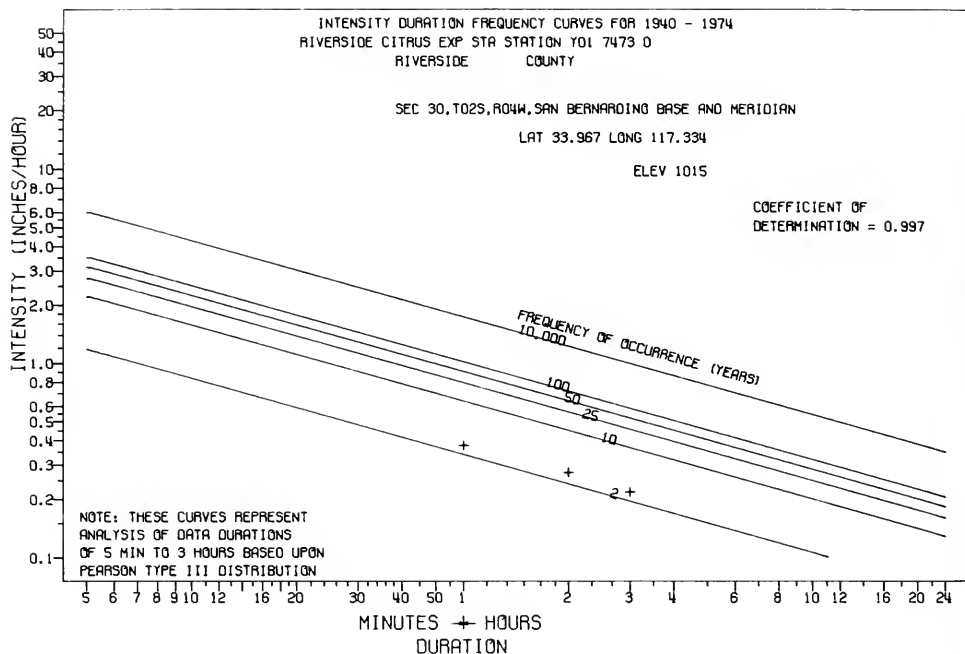


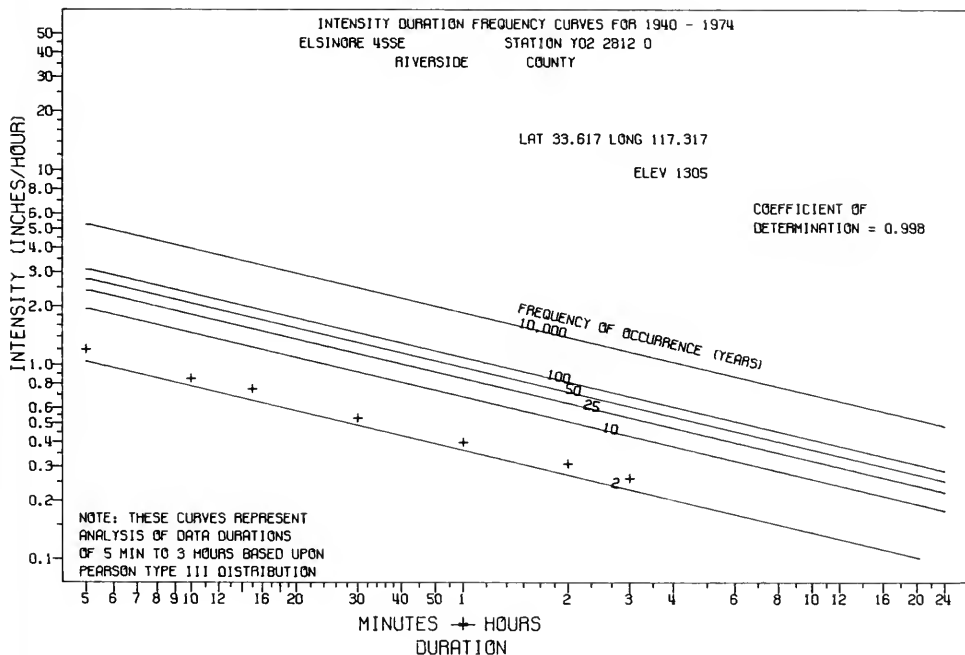
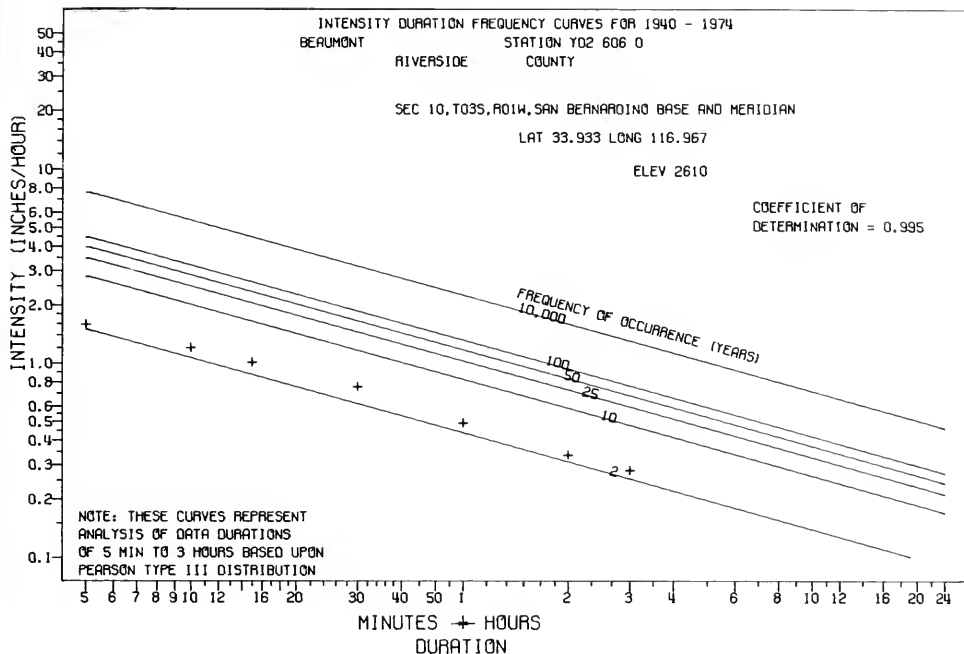


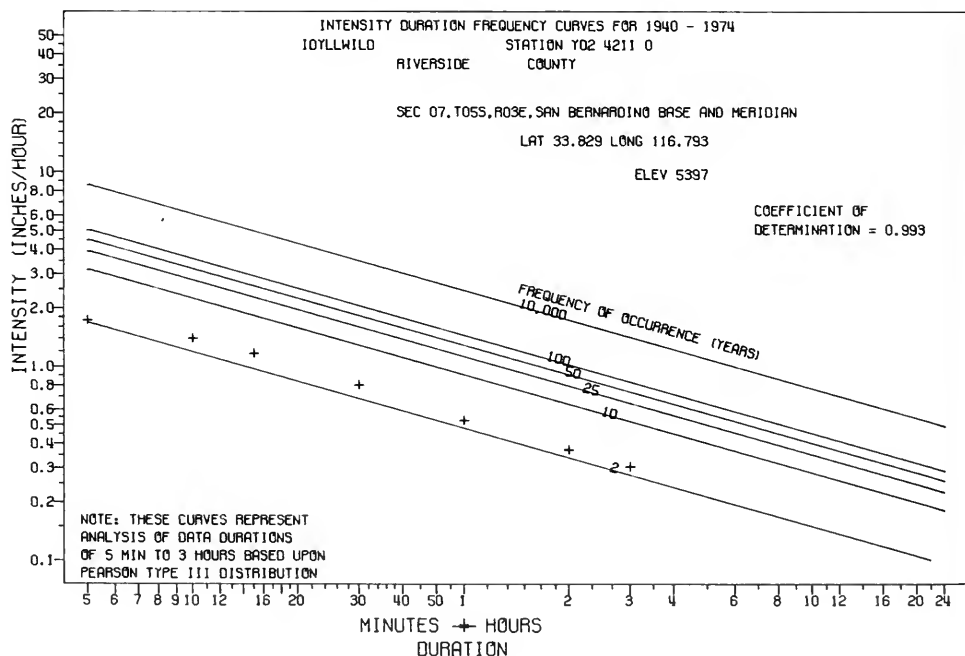
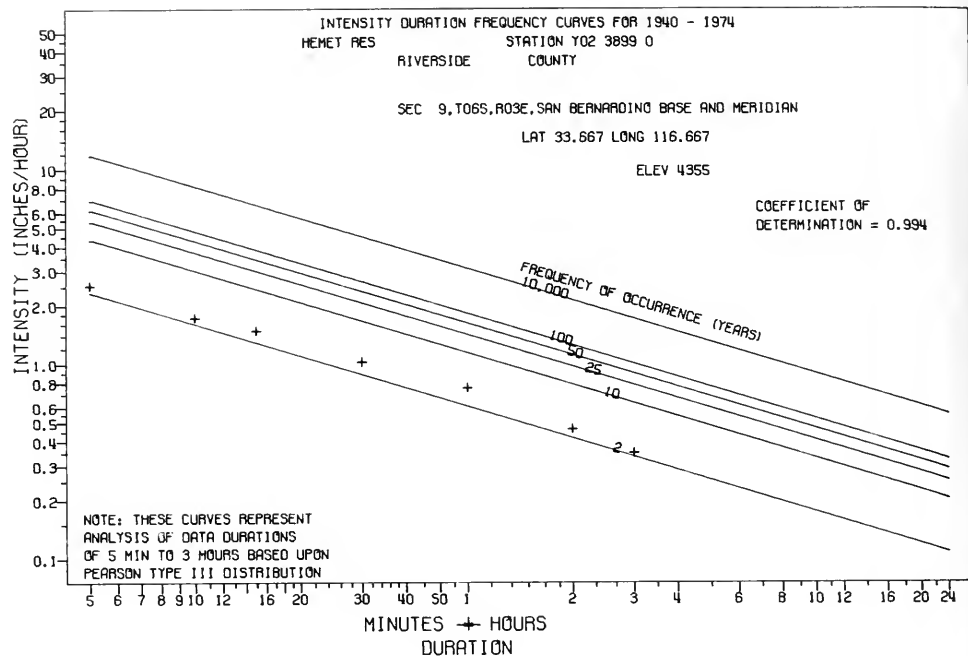


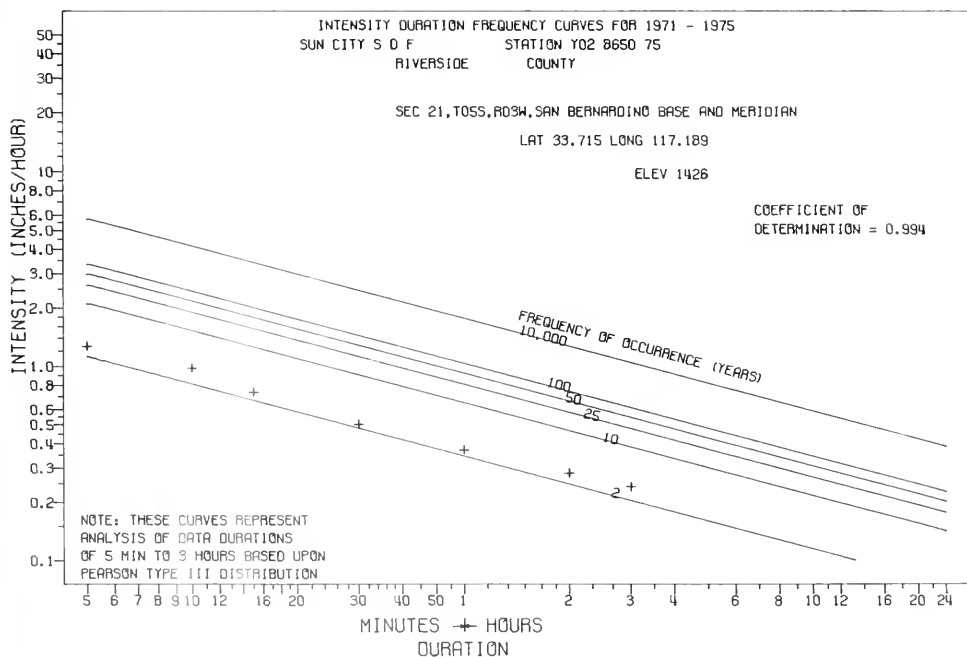
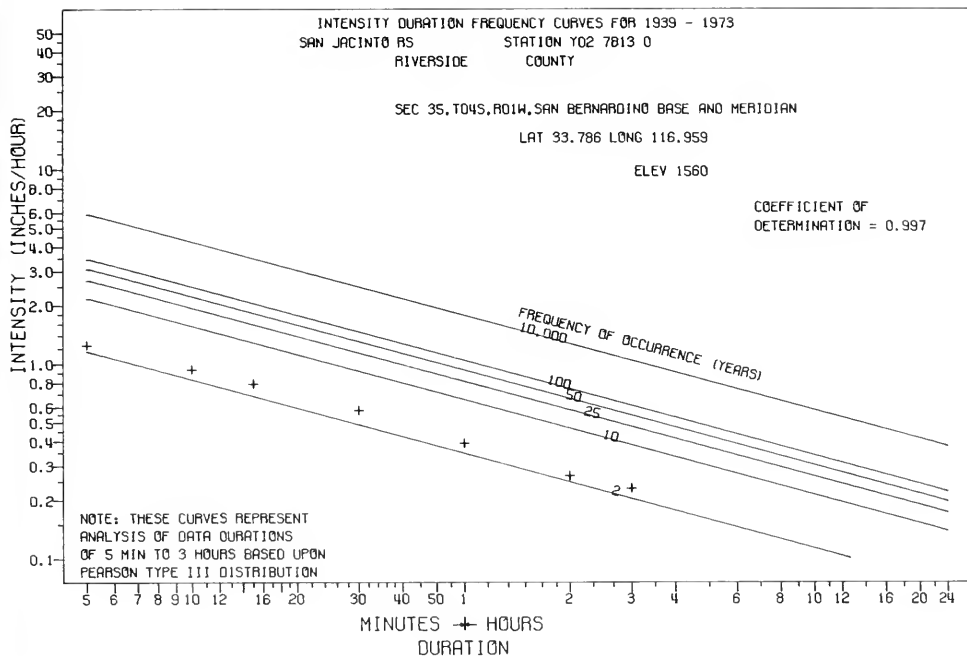


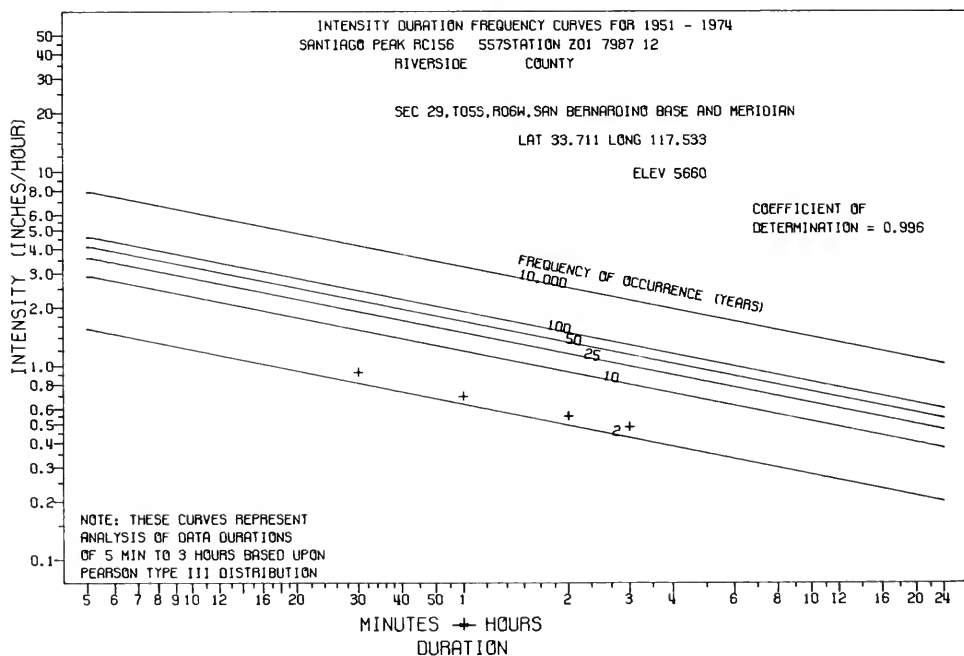
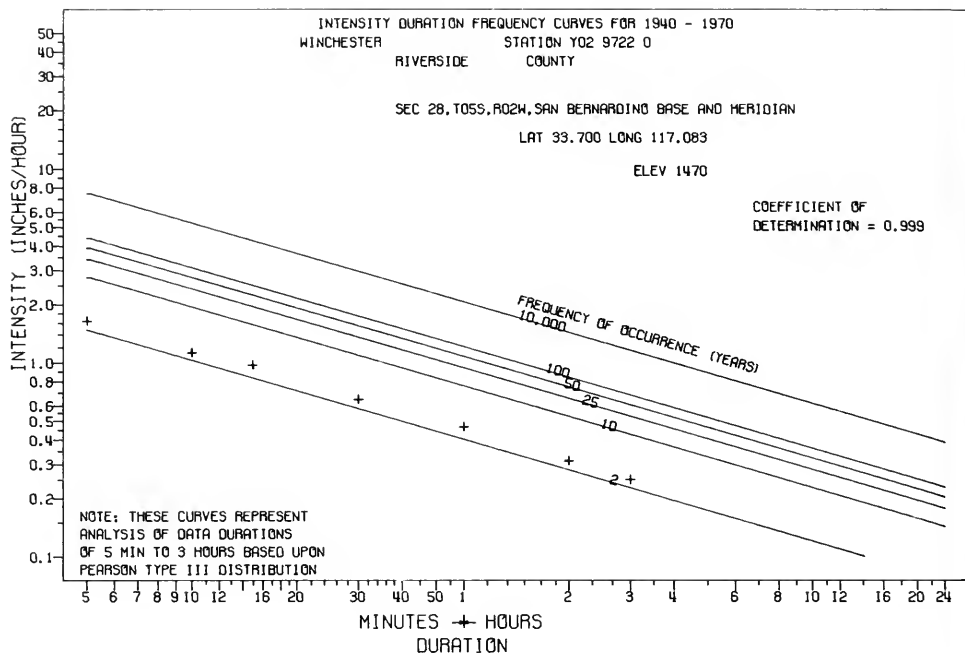


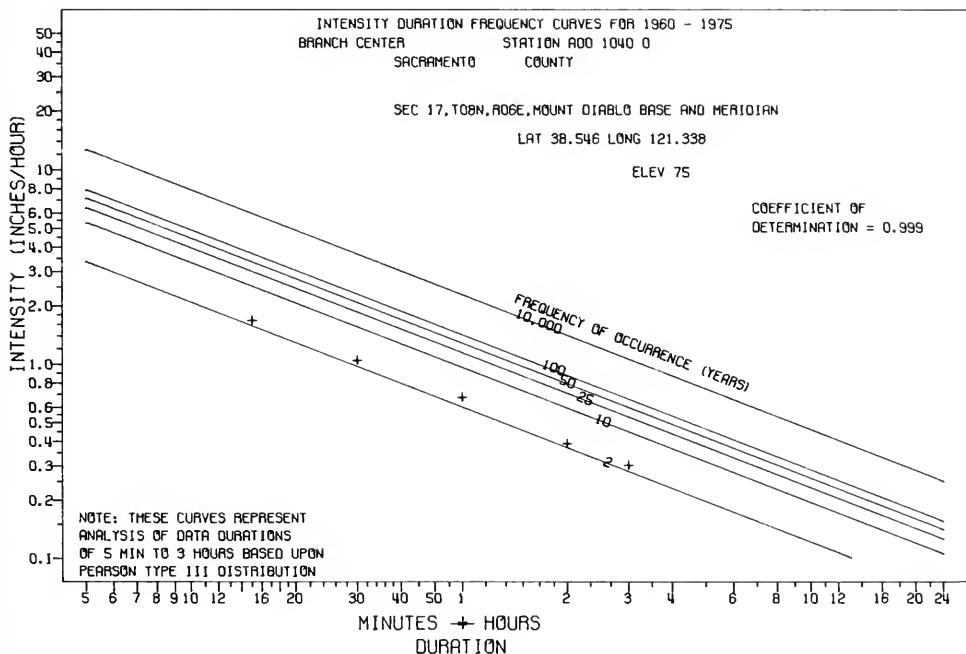
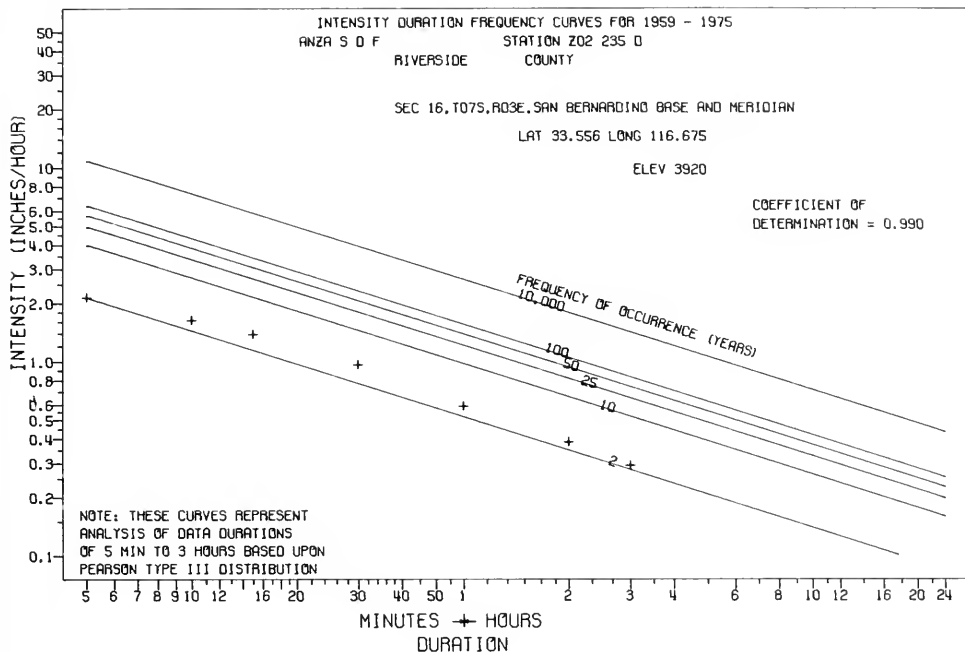


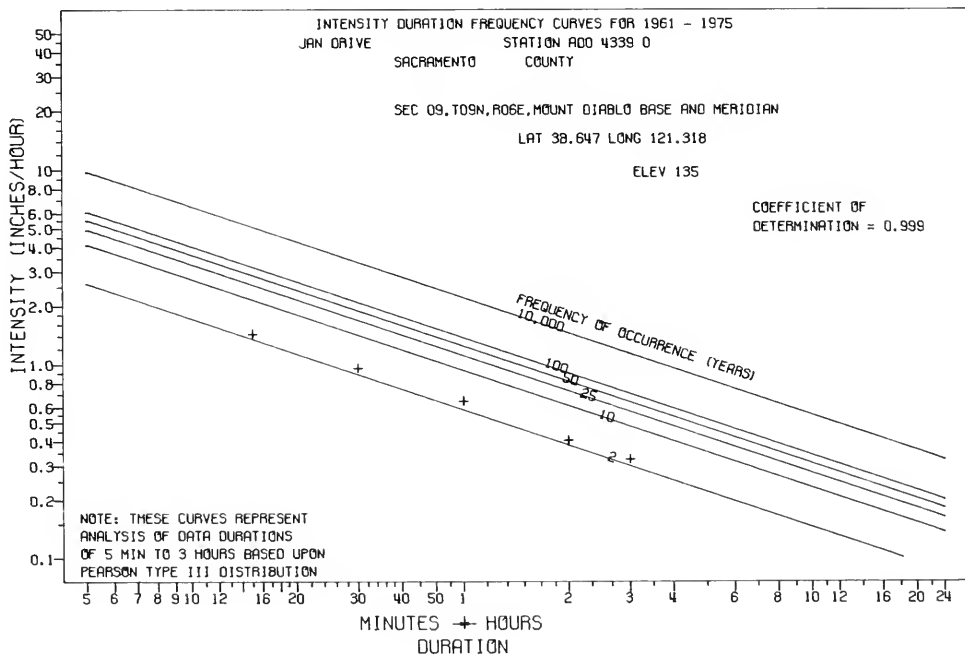
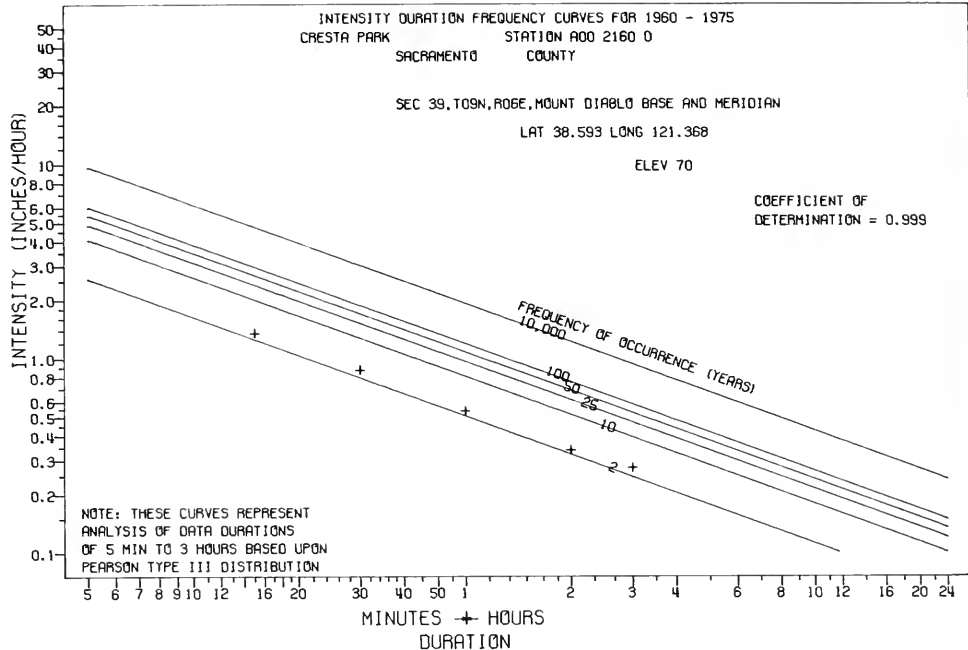


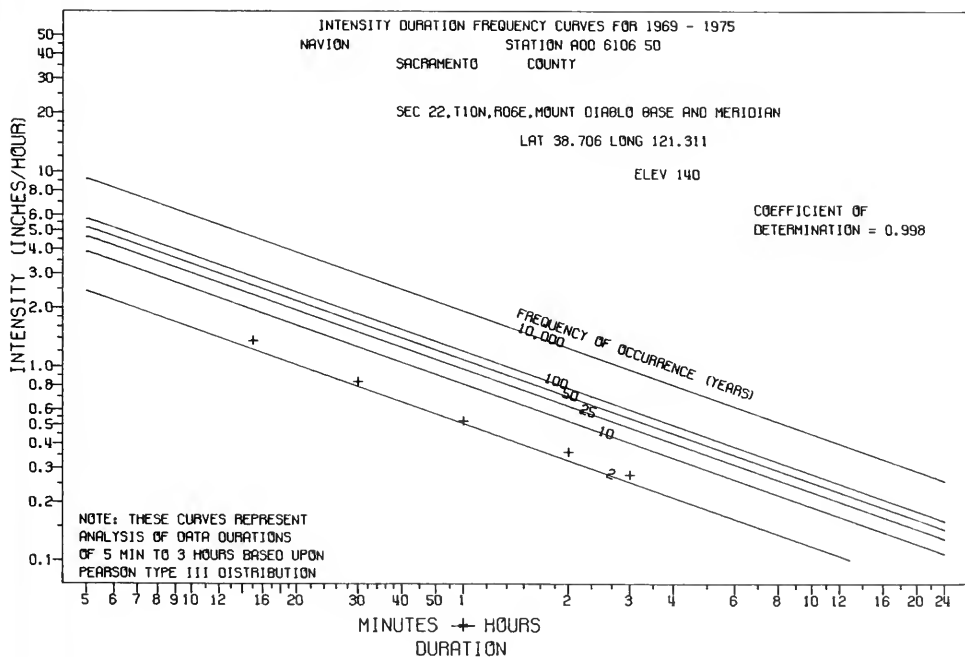
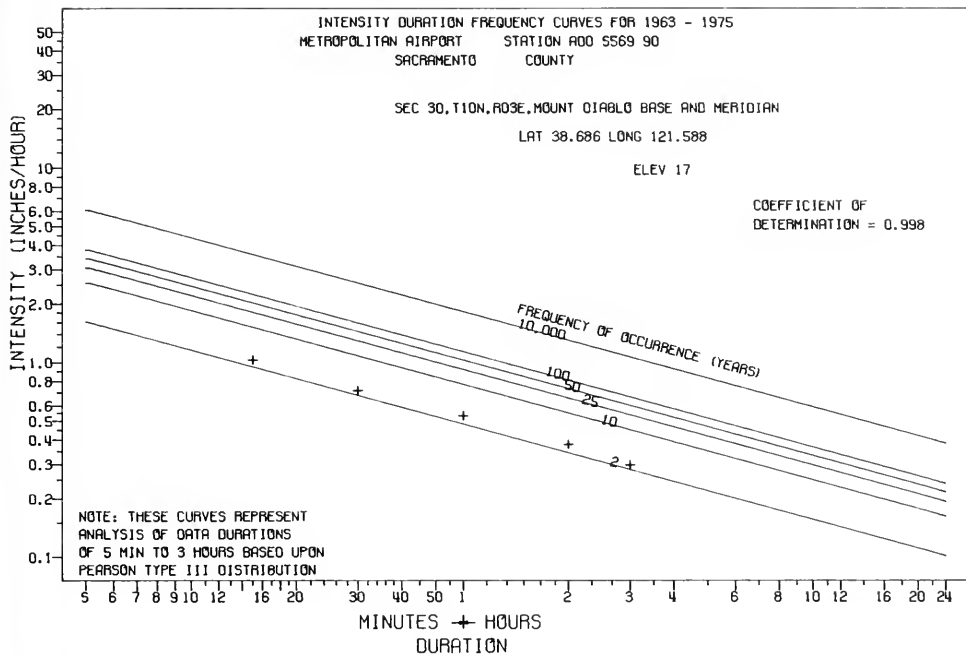


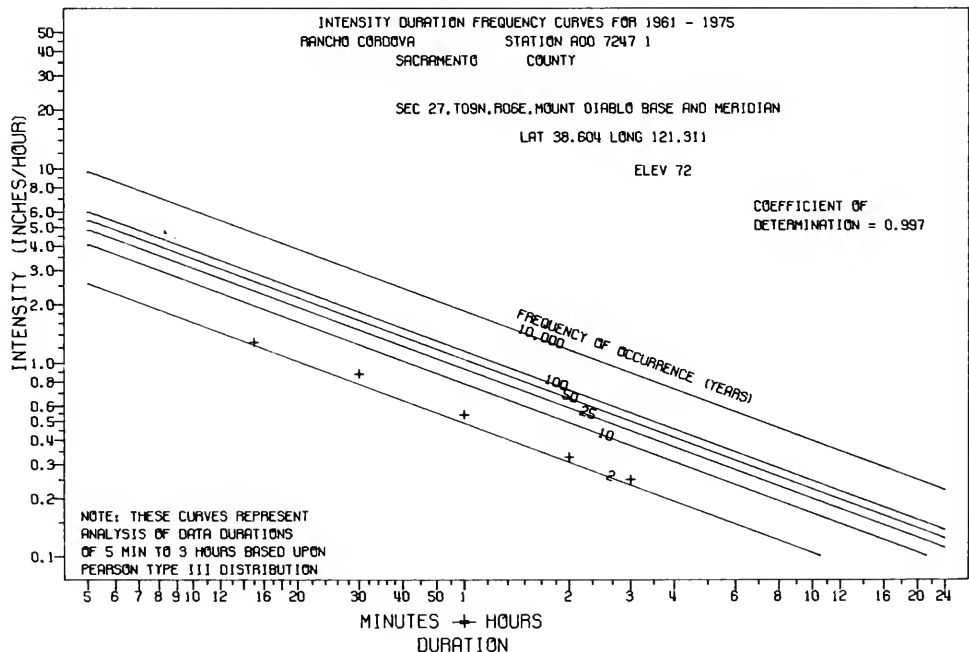
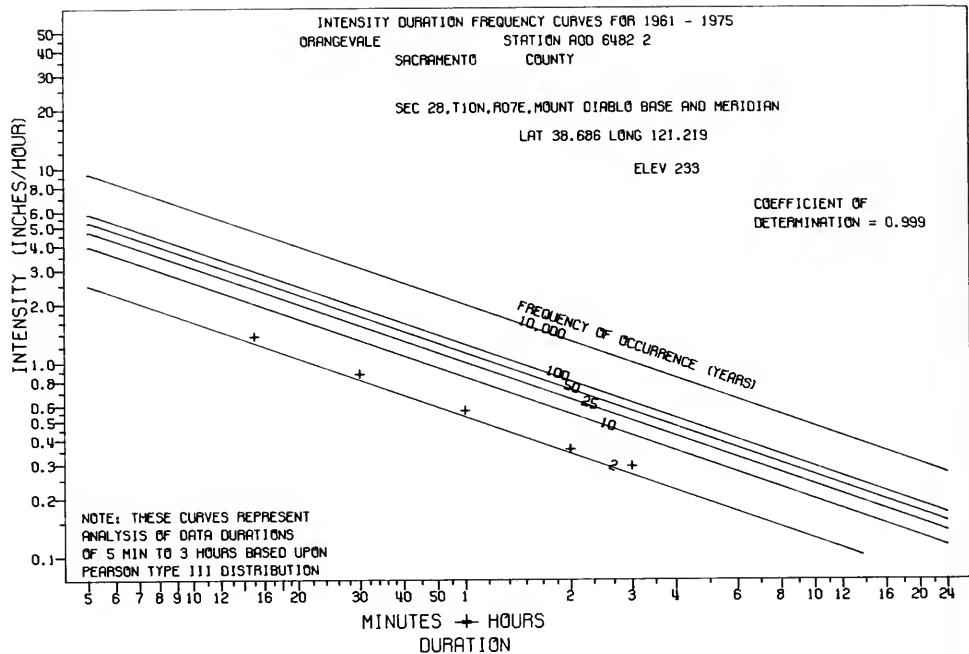








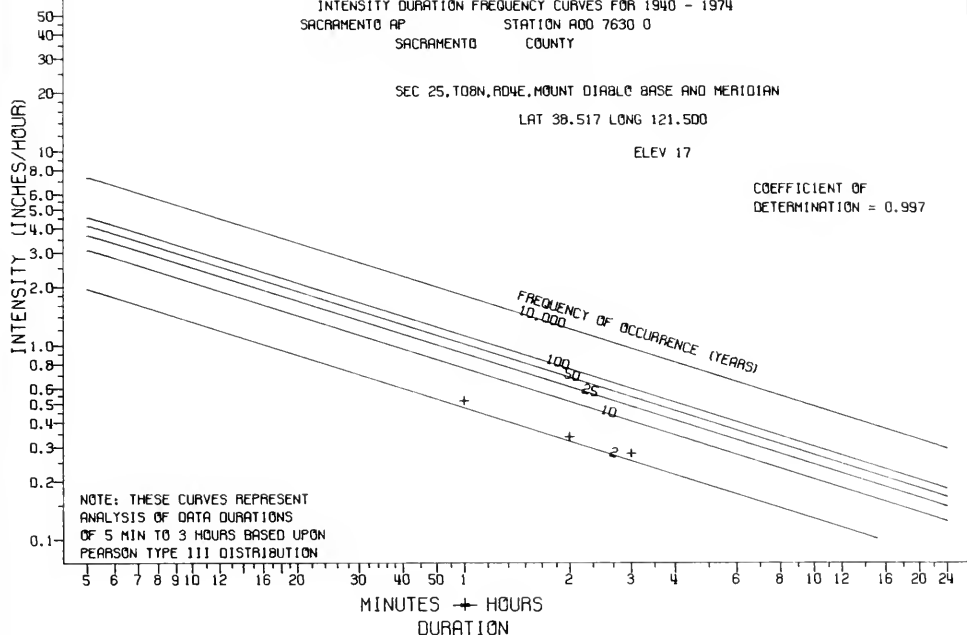




INTENSITY DURATION FREQUENCY CURVES FOR 1940 - 1974
SACRAMENTO AP STATION AOD 7630 0
SACRAMENTO COUNTY

SEC 25, T08N, R04E, MOUNT DIABLO BASE AND MERIDIAN
LAT 38.517 LONG 121.500
ELEV 17

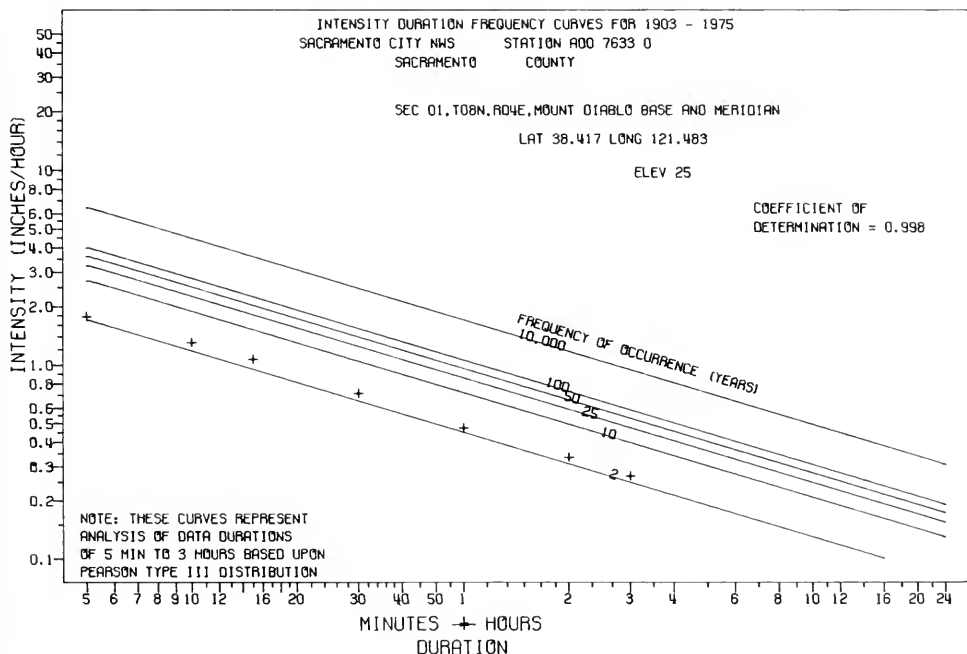
COEFFICIENT OF
DETERMINATION = 0.997

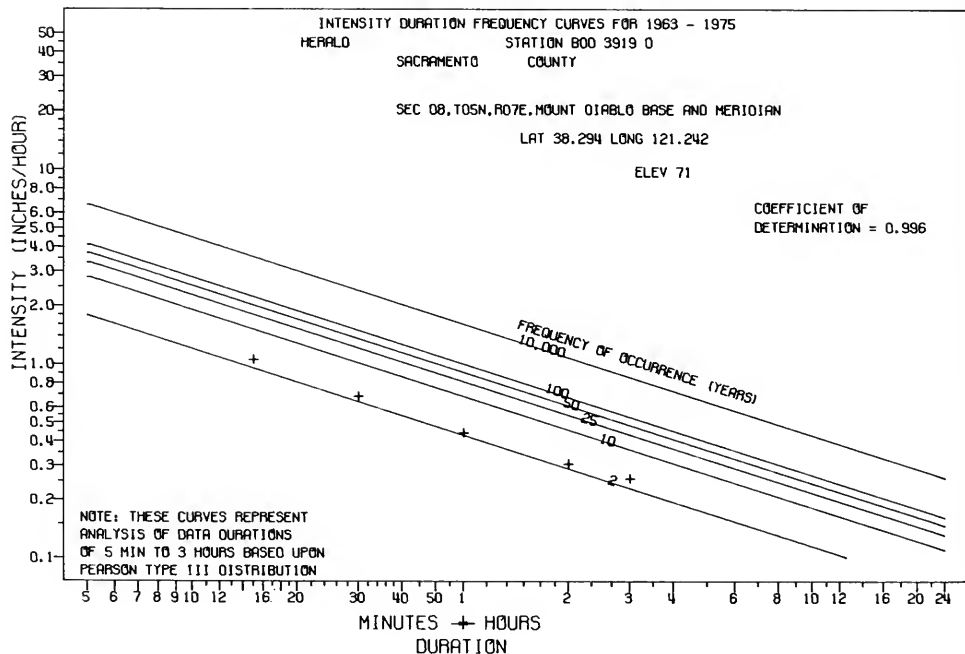
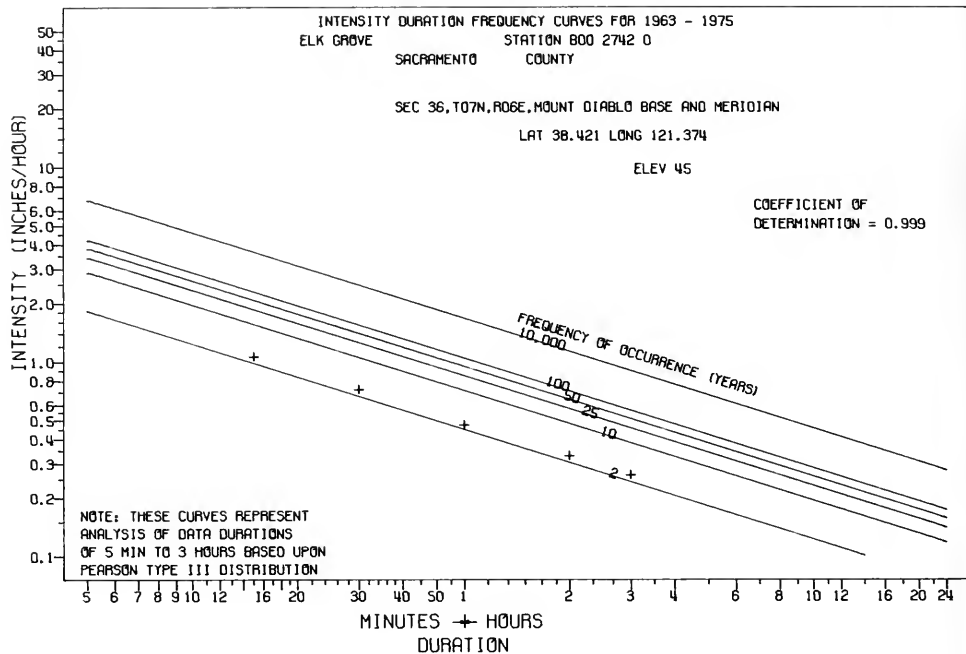


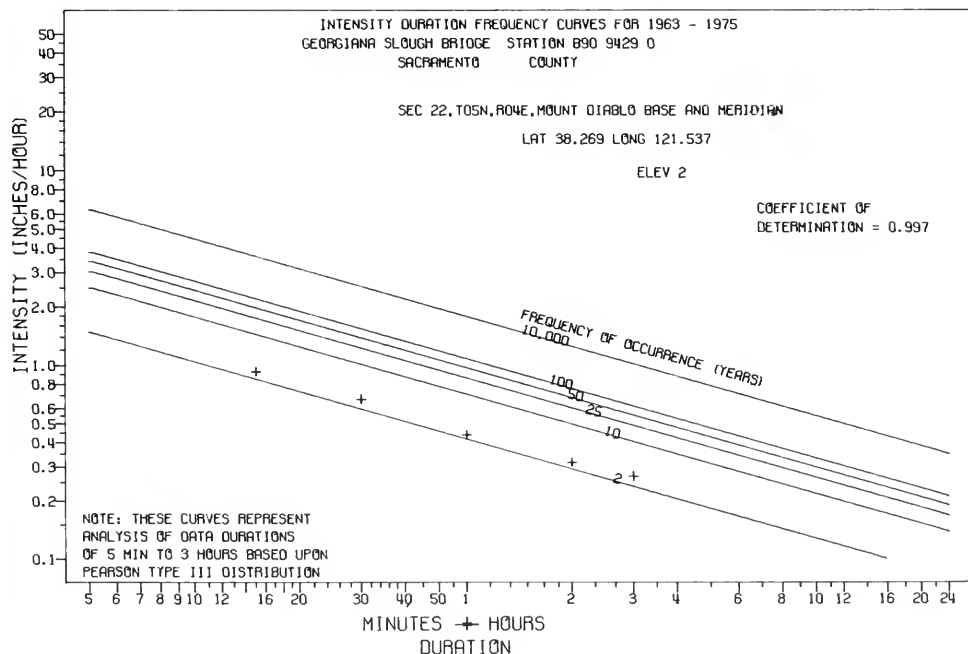
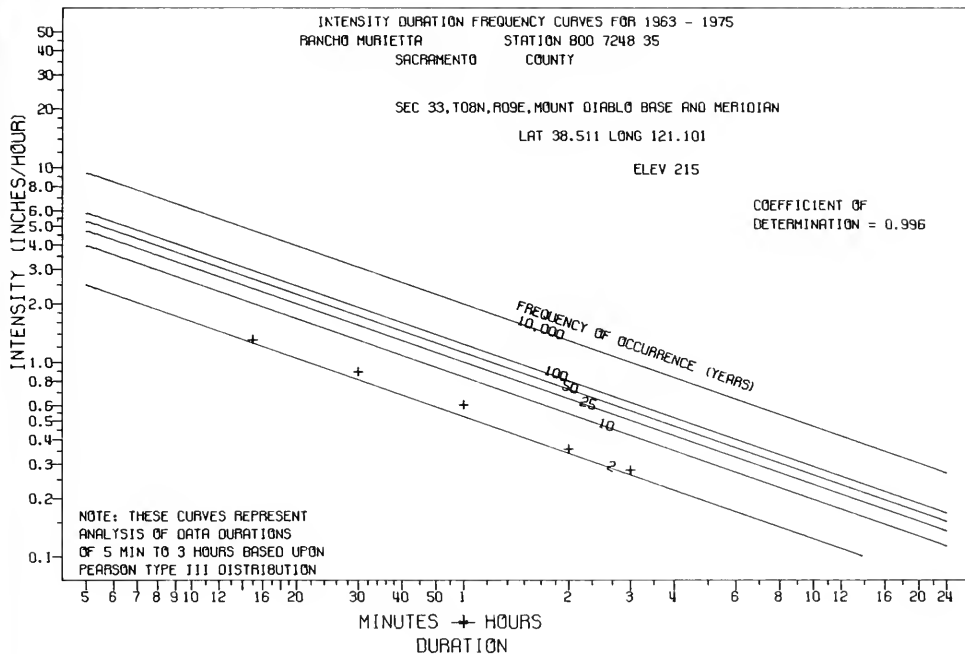
INTENSITY DURATION FREQUENCY CURVES FOR 1903 - 1975
SACRAMENTO CITY NHS STATION AOD 7633 0
SACRAMENTO COUNTY

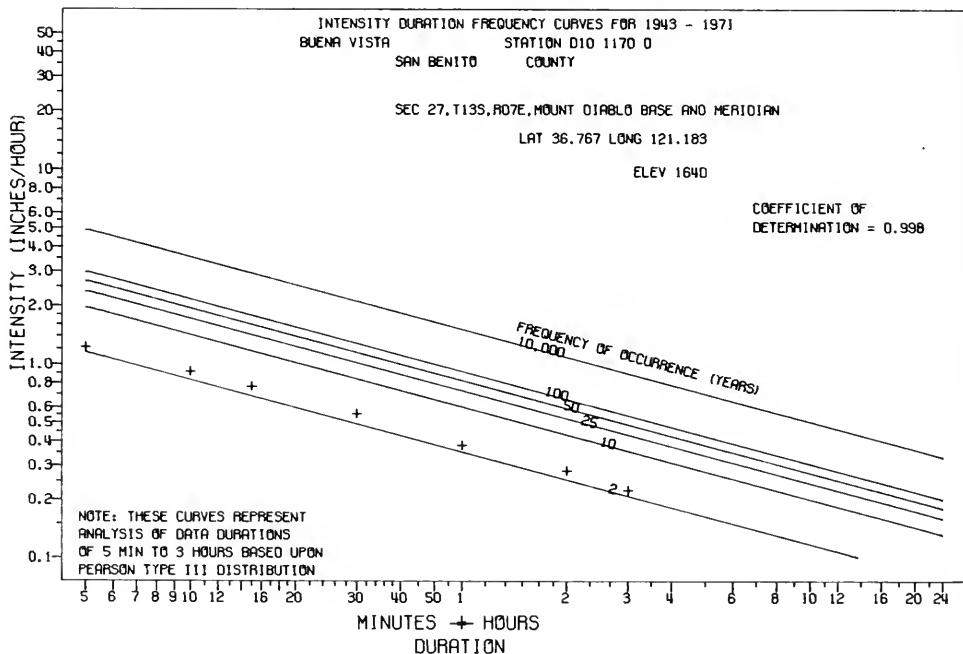
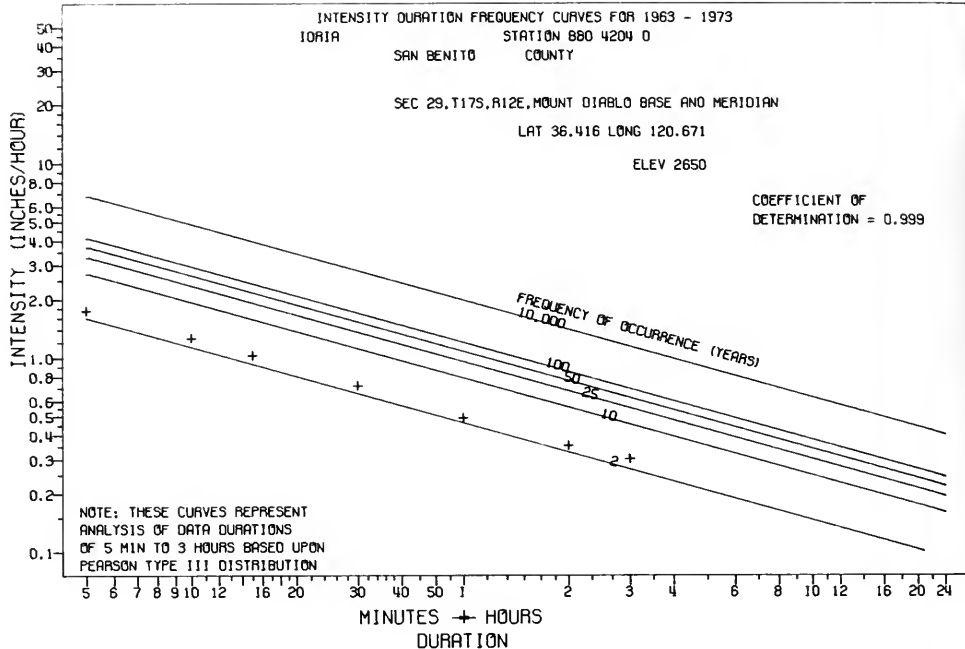
SEC 01, T08N, R04E, MOUNT DIABLO BASE AND MERIDIAN
LAT 38.417 LONG 121.483
ELEV 25

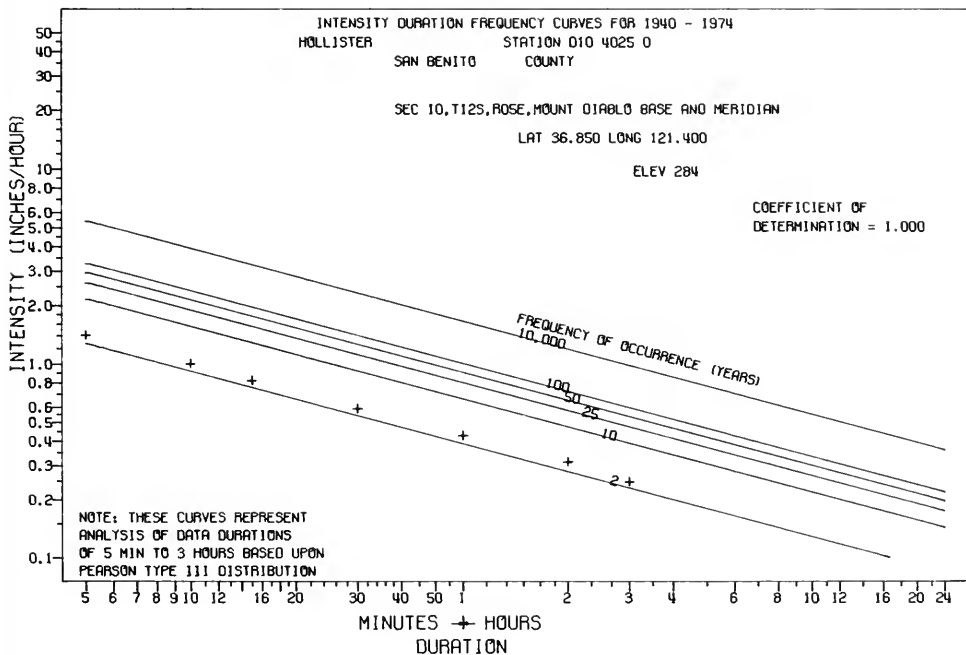
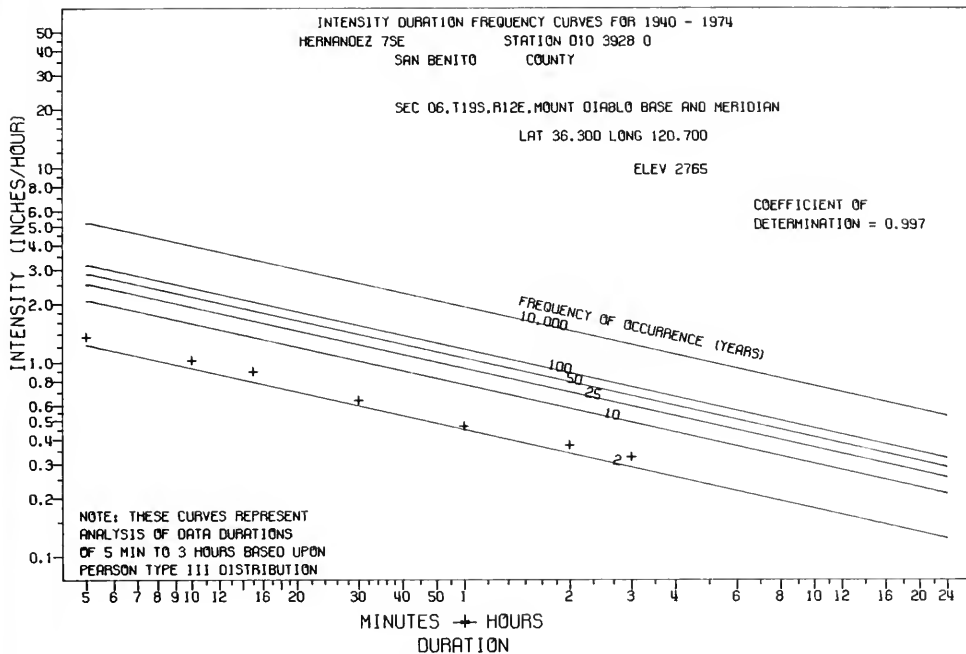
COEFFICIENT OF
DETERMINATION = 0.998

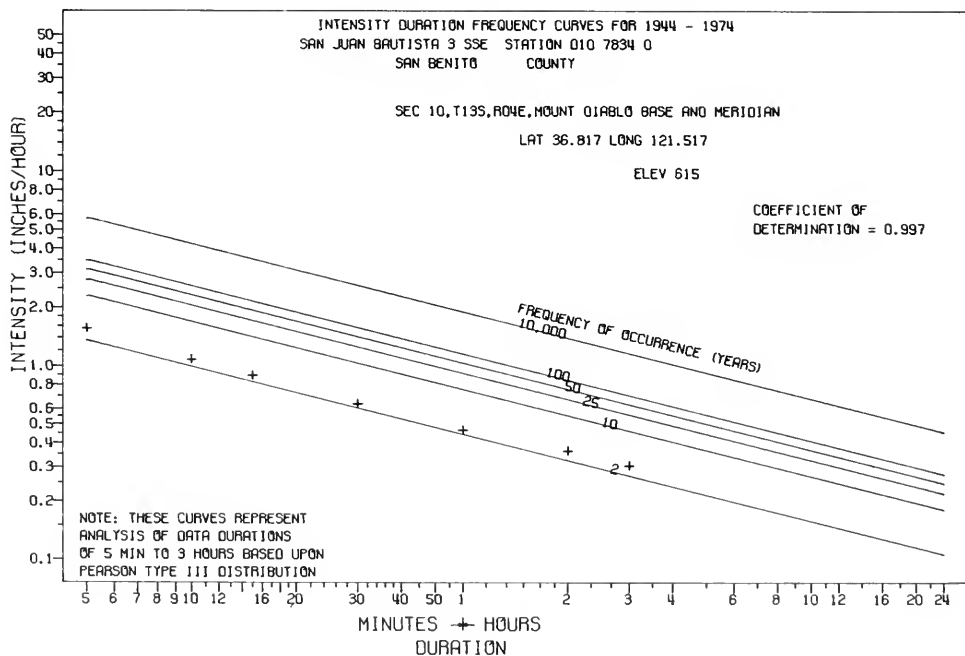
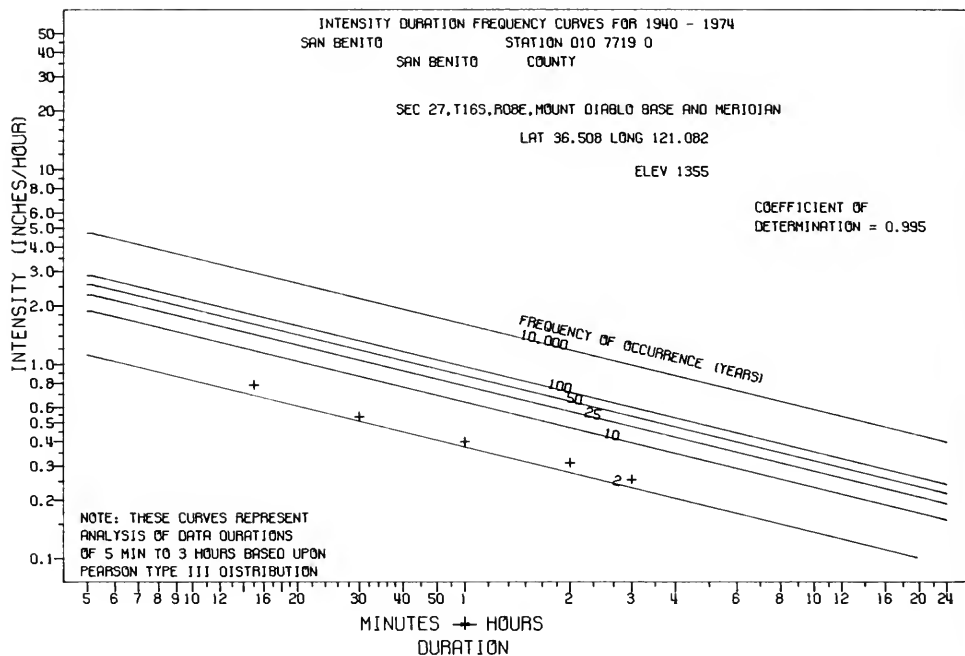


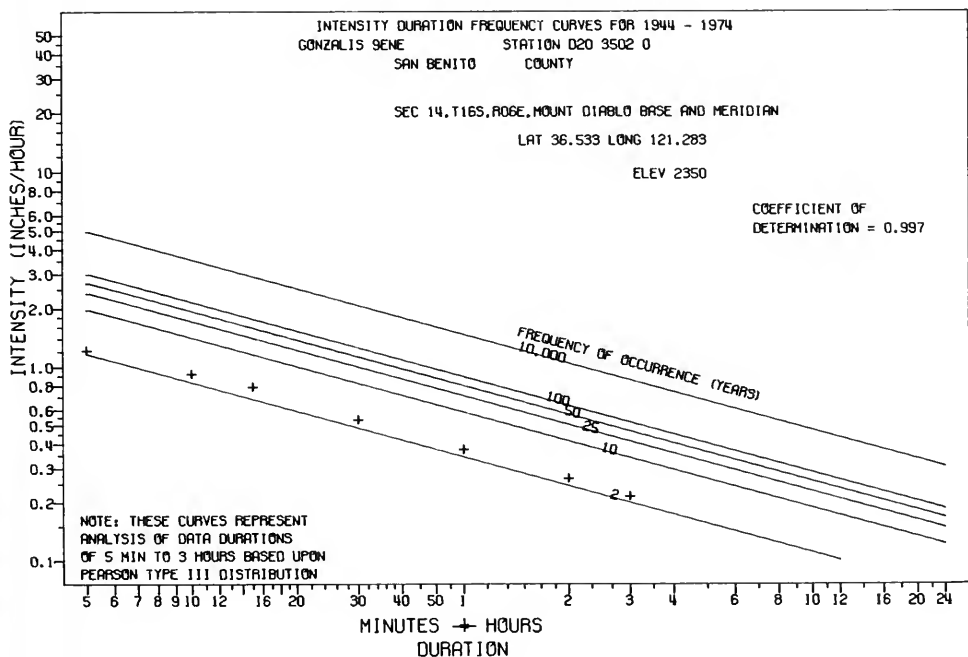
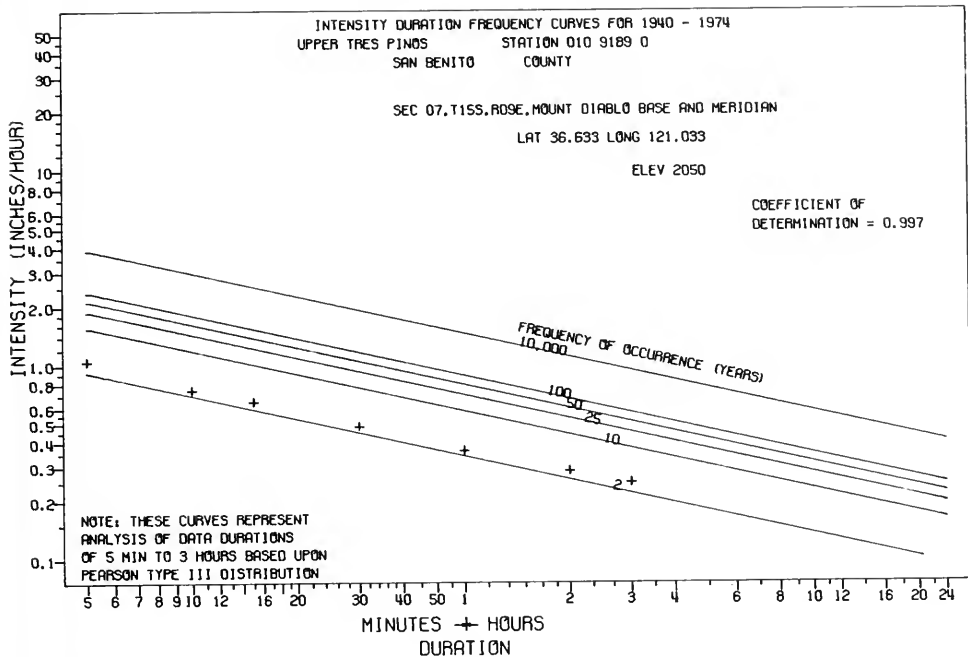


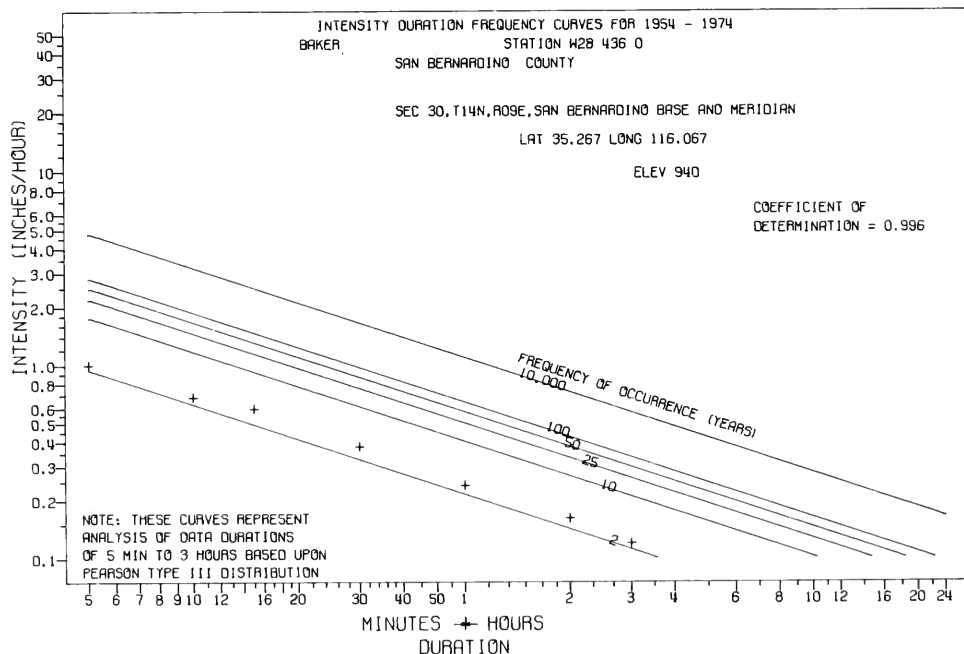
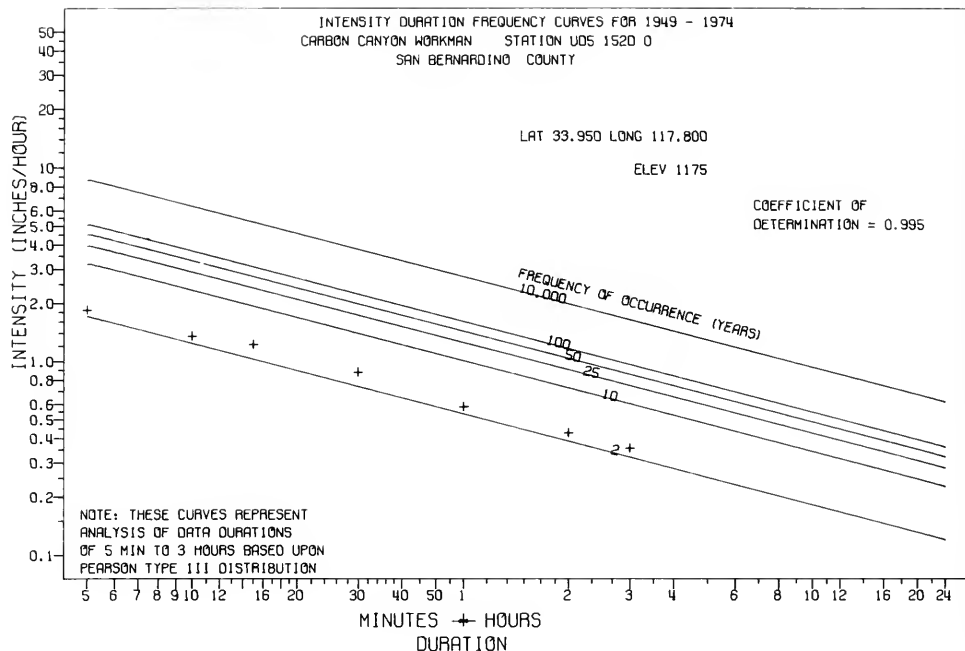


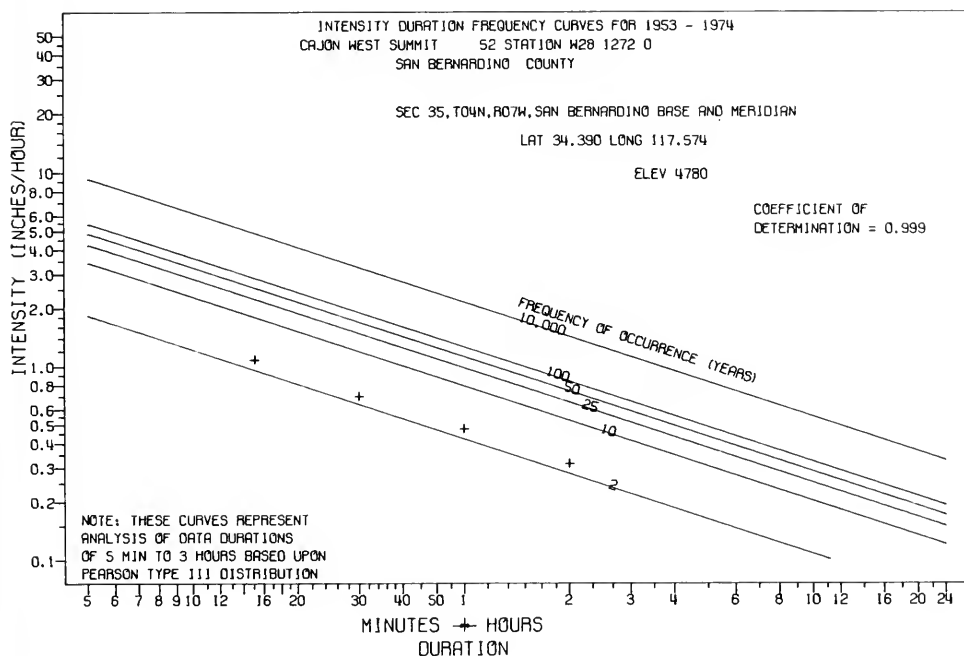
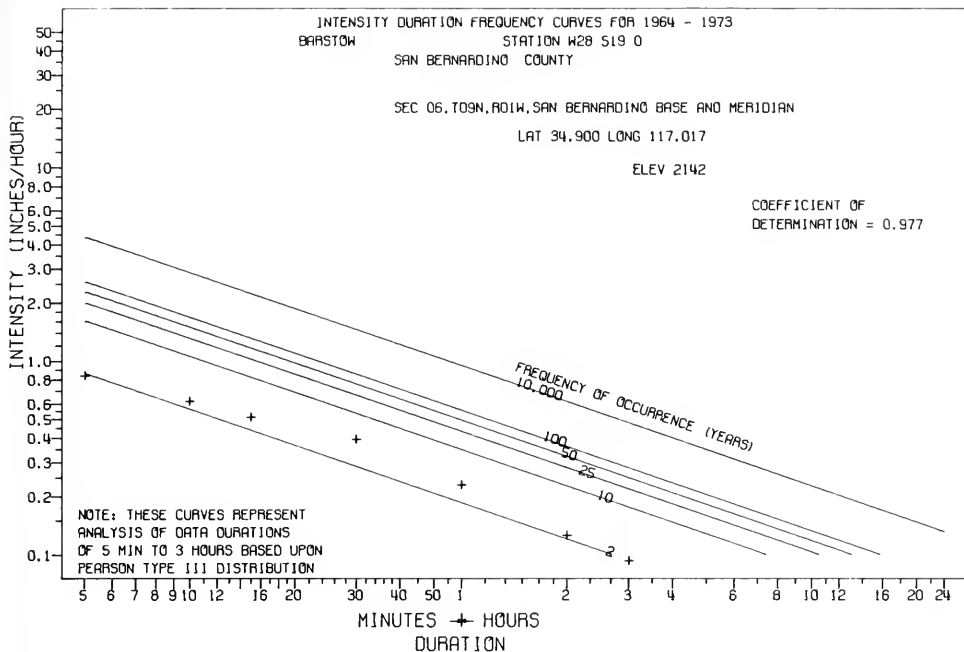


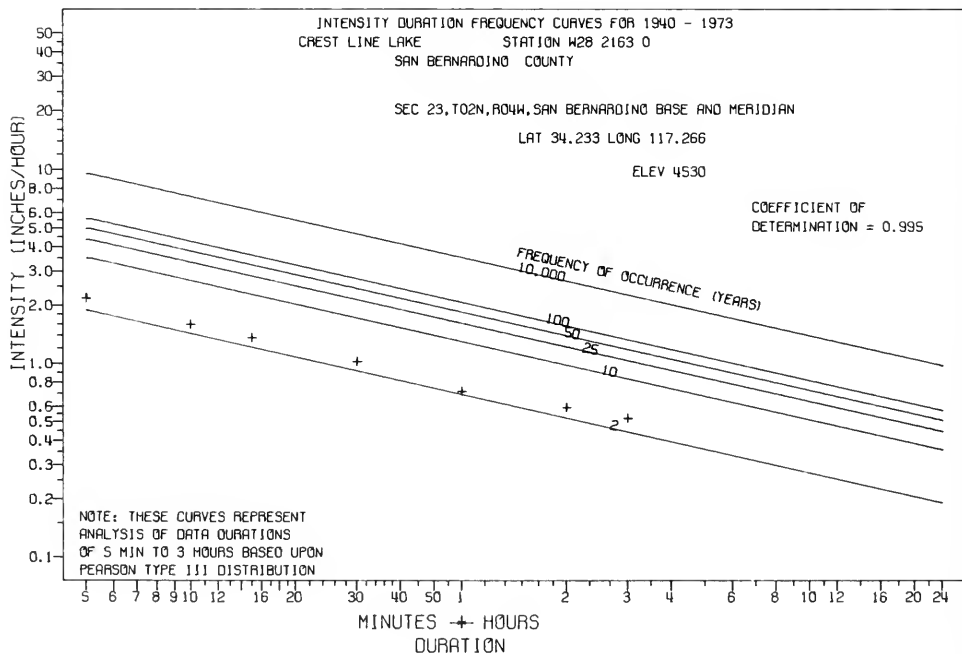
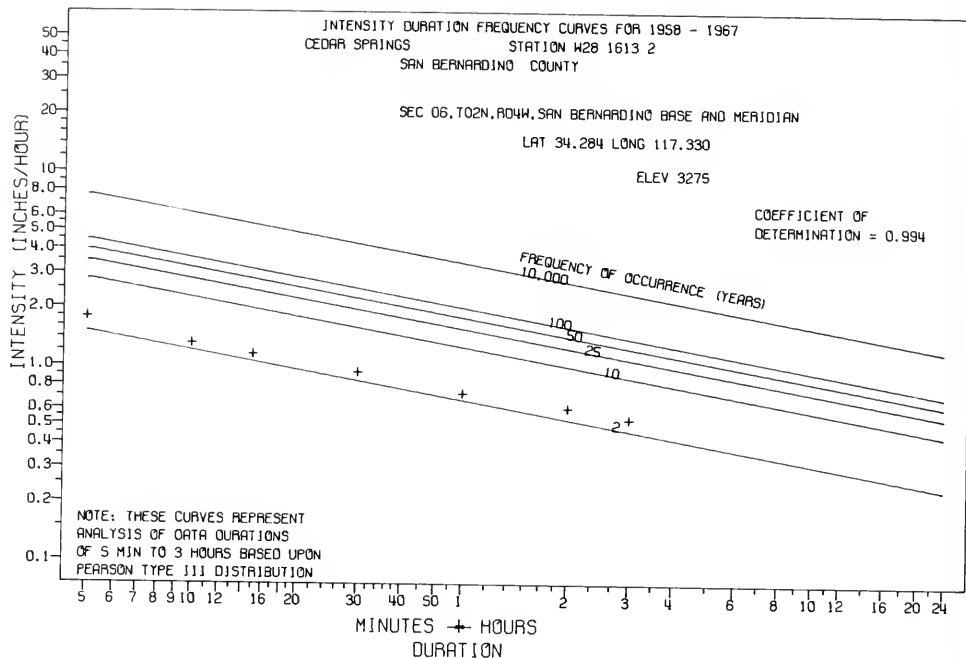


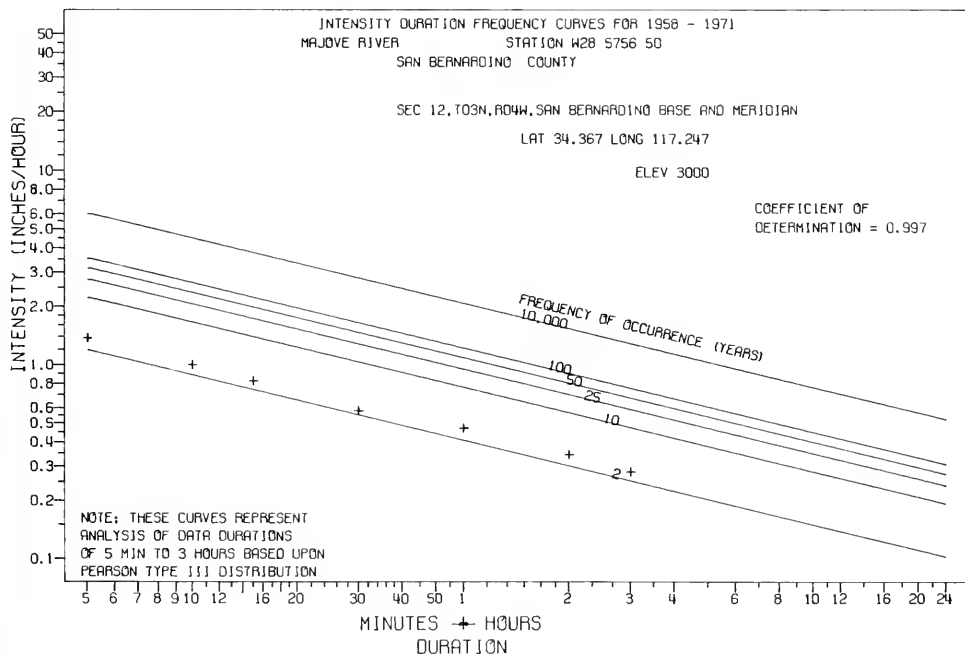
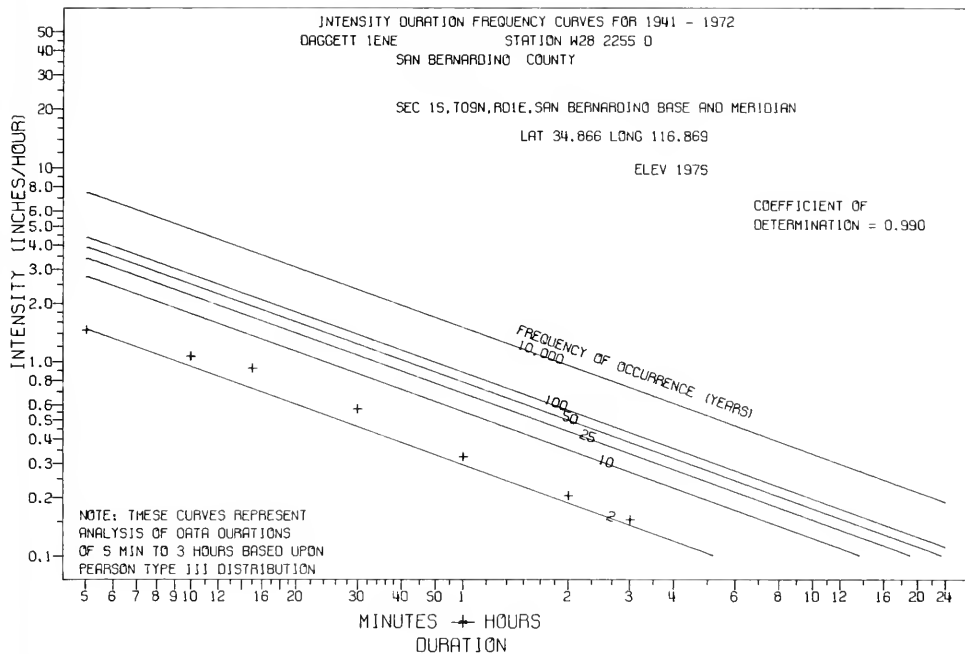


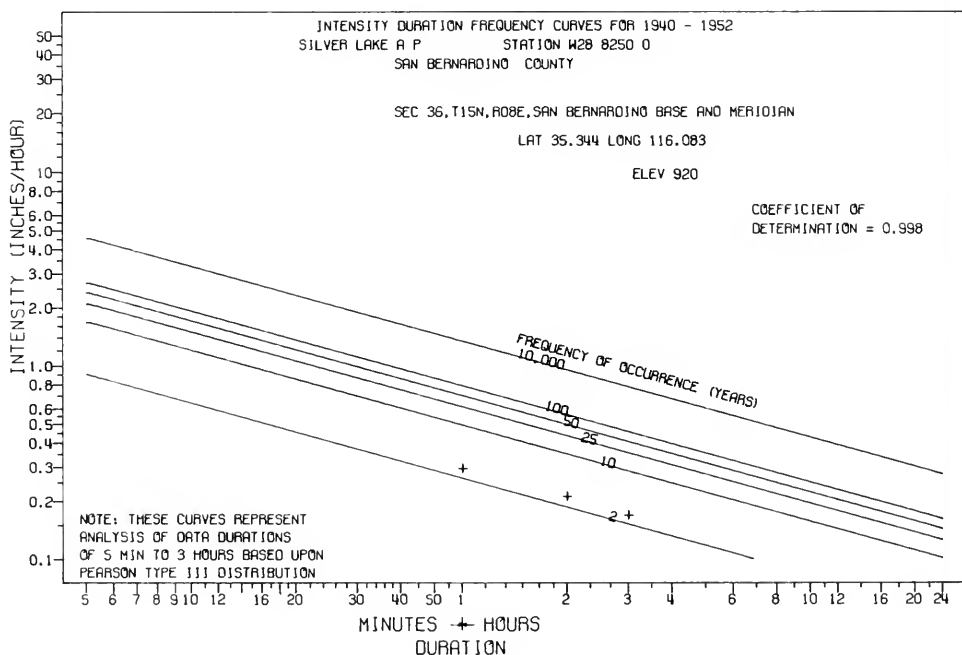
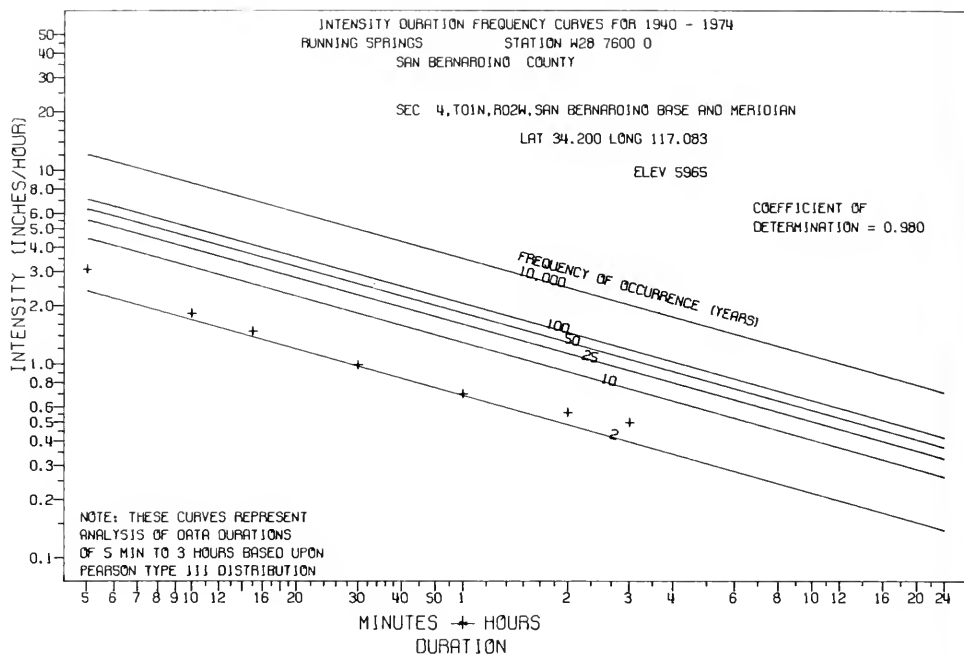


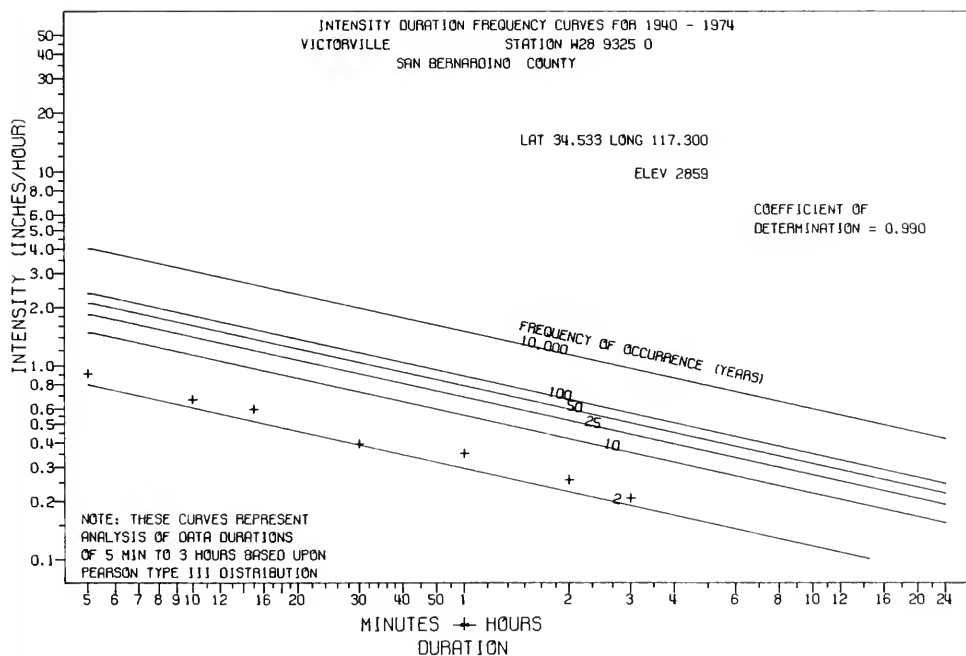
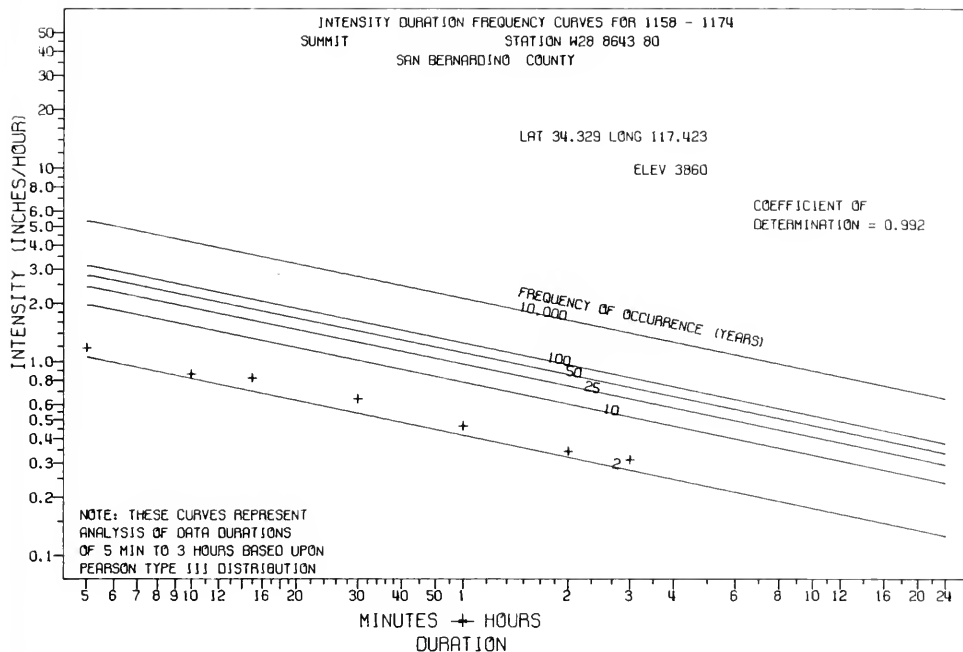


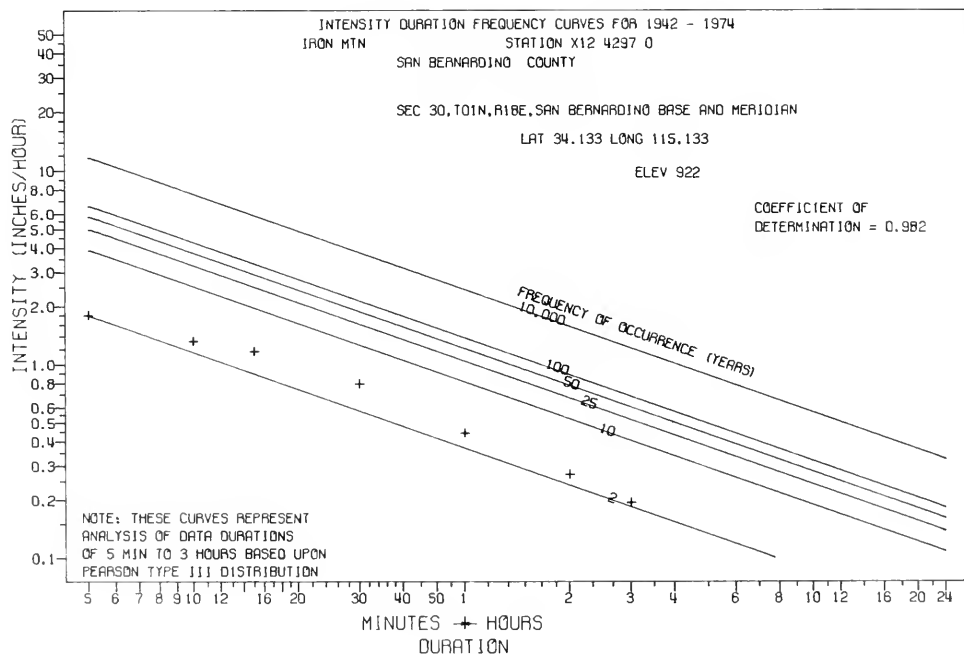
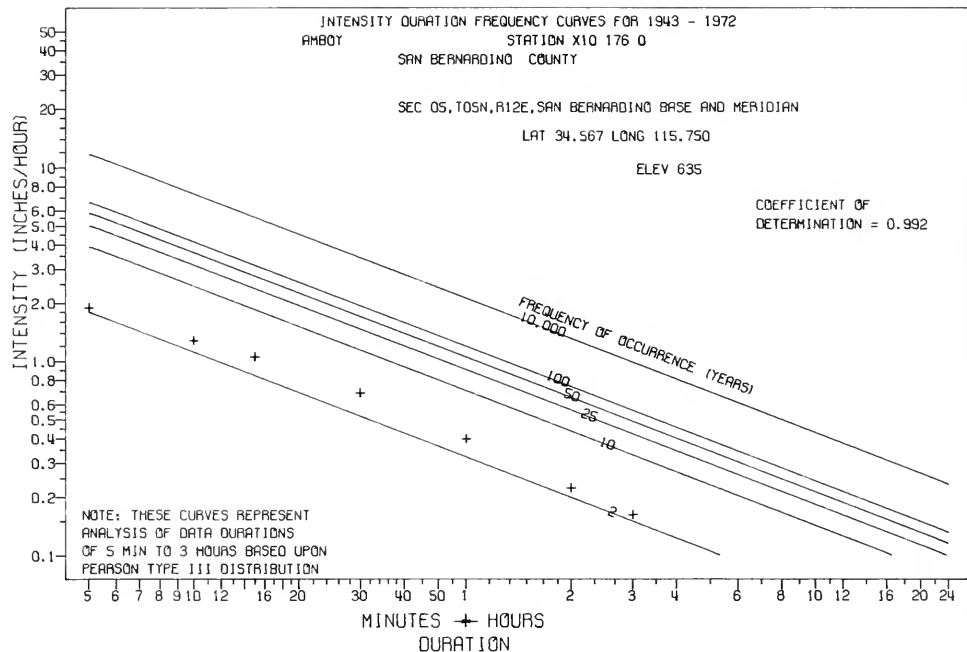


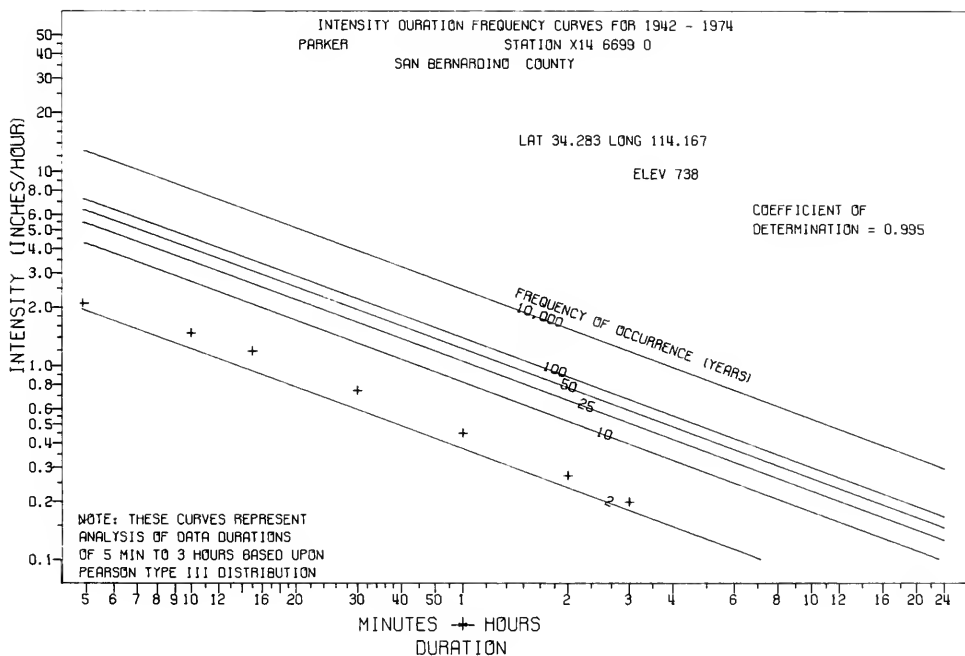
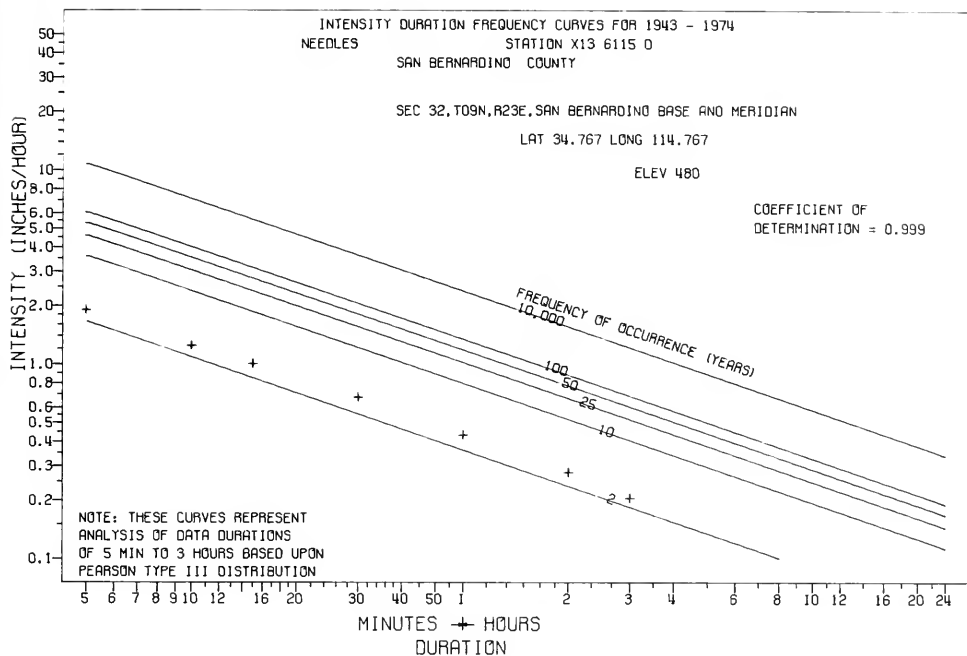


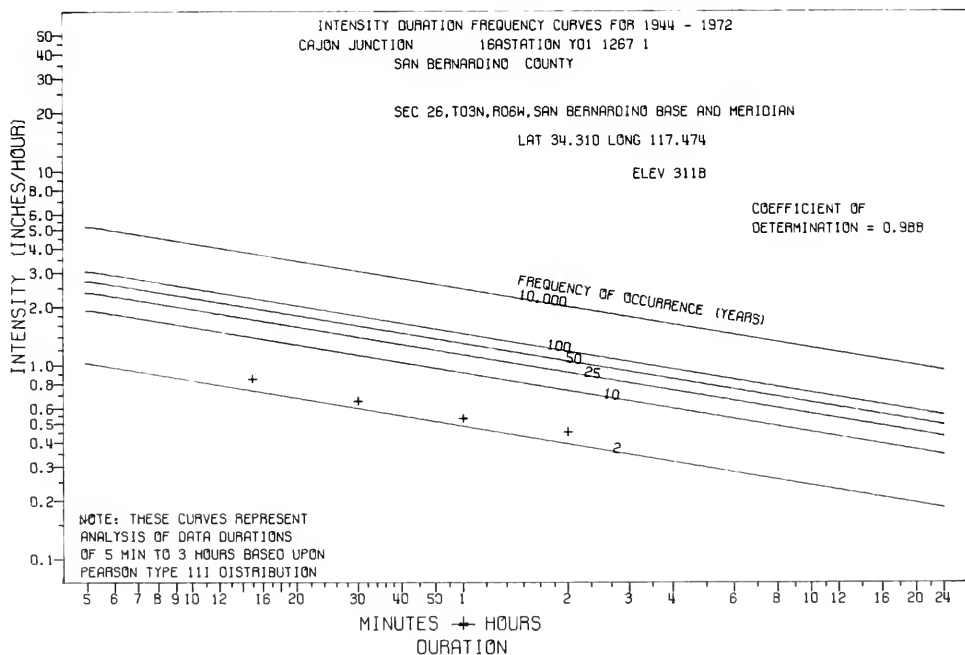
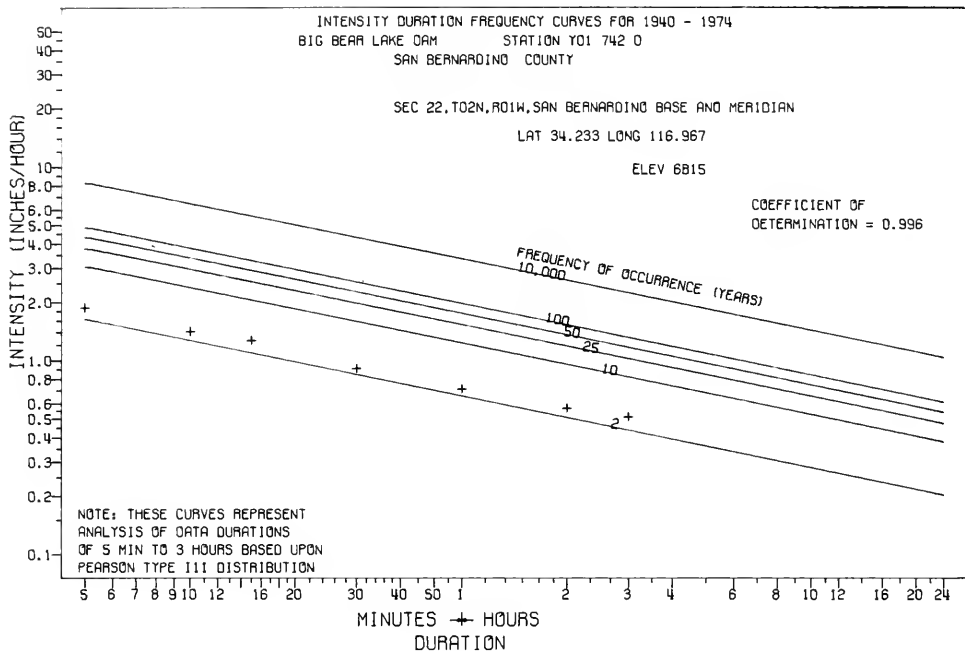












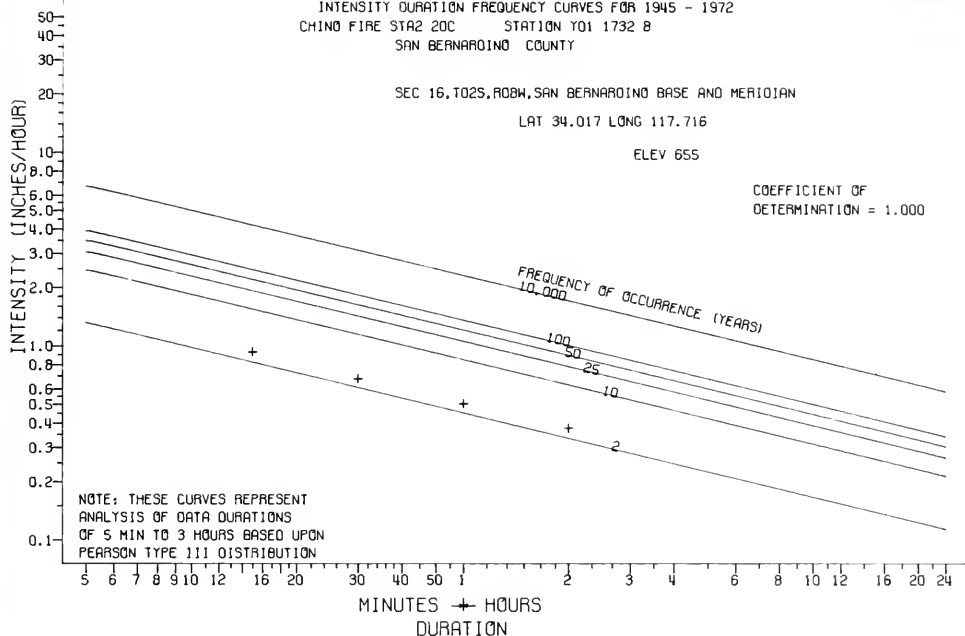
INTENSITY DURATION FREQUENCY CURVES FOR 1945 - 1972
CHINO FIRE STA2 20C STATION Y01 1732 B
SAN BERNARDINO COUNTY

SEC 16, T02S, R08W, SAN BERNARDINO BASE AND MERIDIAN

LAT 34.017 LONG 117.716

ELEV 655

COEFFICIENT OF
DETERMINATION = 1.000



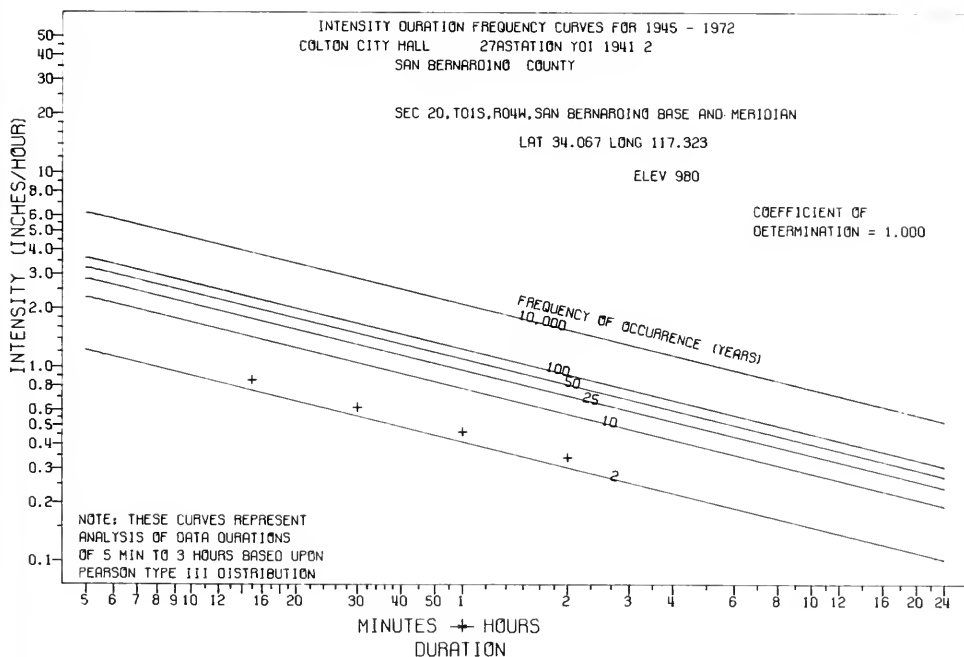
INTENSITY DURATION FREQUENCY CURVES FOR 1945 - 1972
COLTON CITY HALL STATION Y01 1941 2
SAN BERNARDINO COUNTY

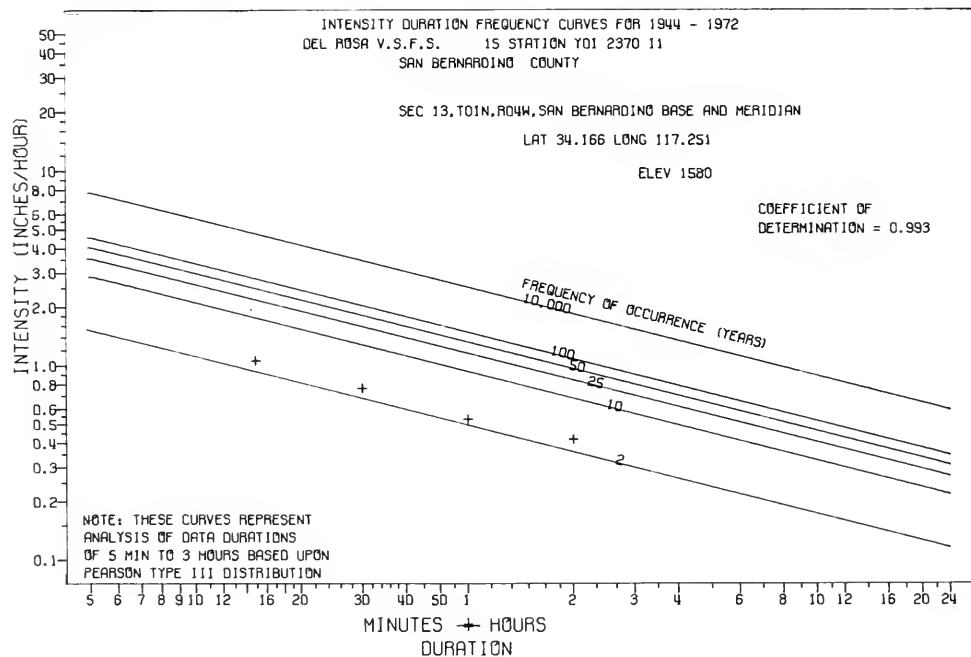
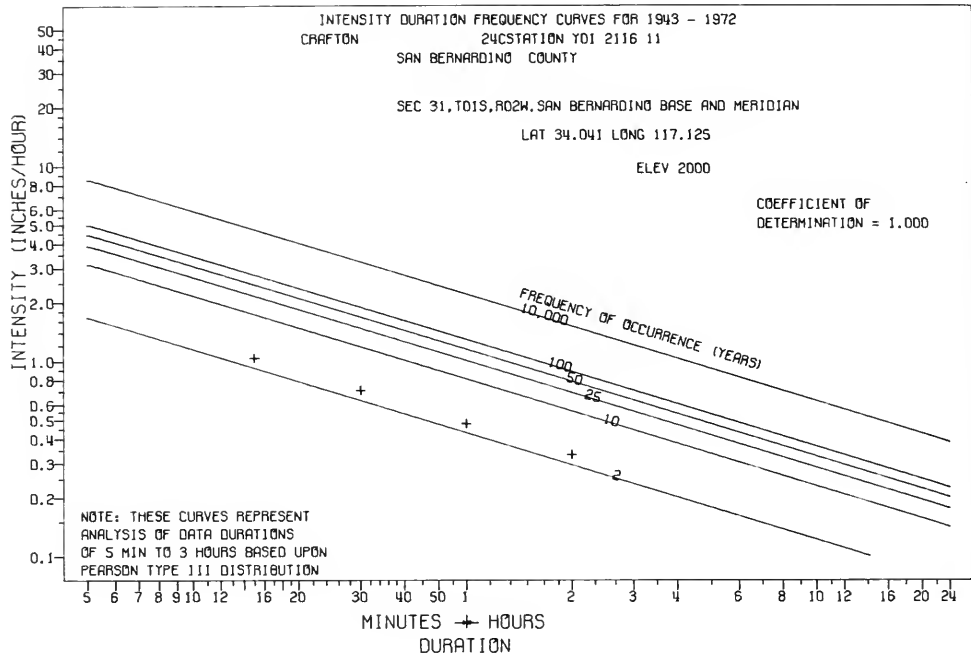
SEC 20, T01S, R04W, SAN BERNARDINO BASE AND MERIDIAN

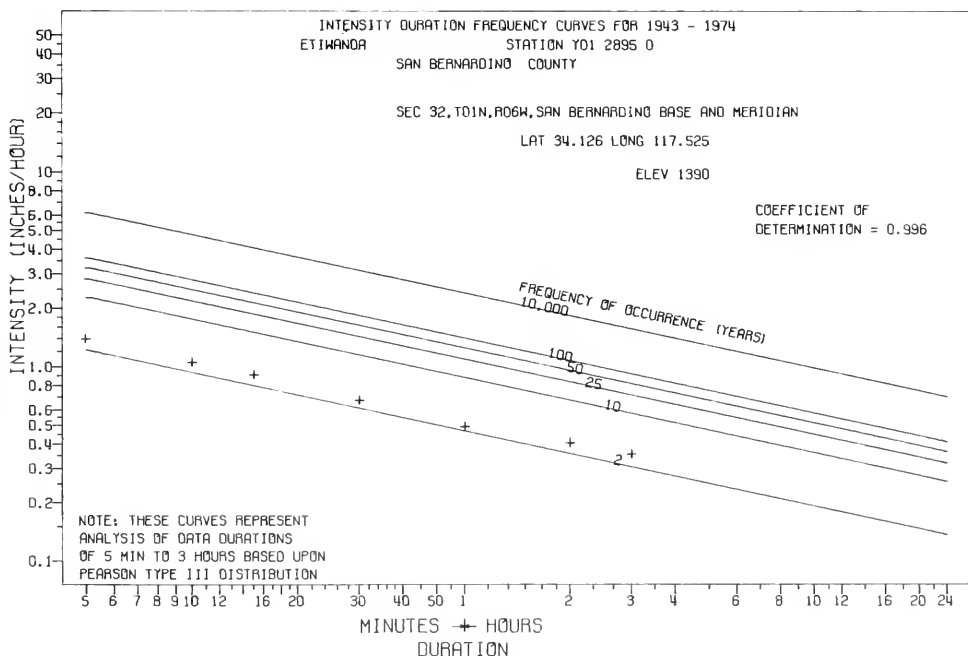
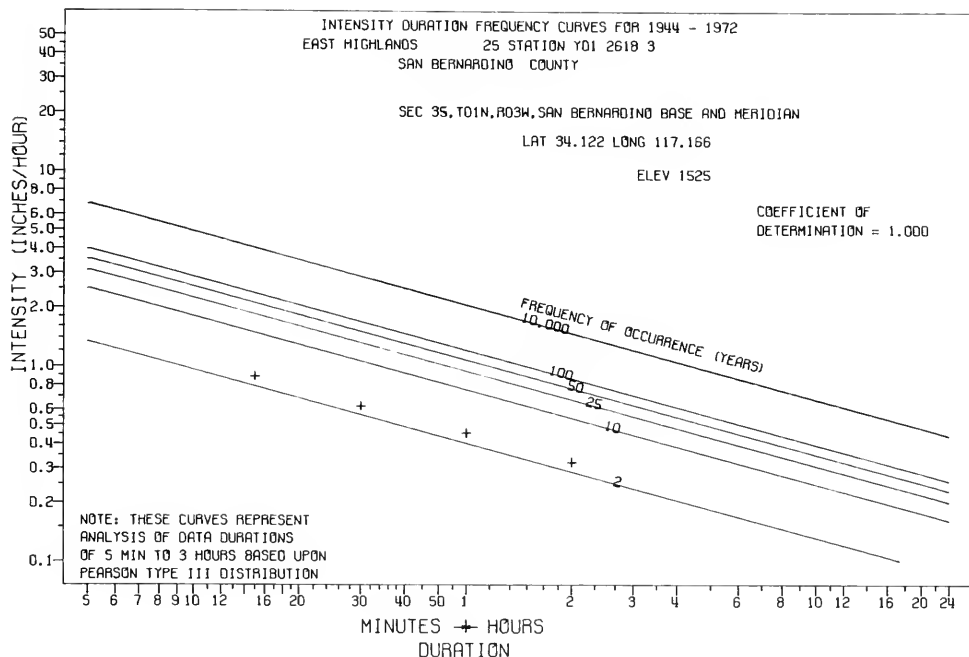
LAT 34.067 LONG 117.323

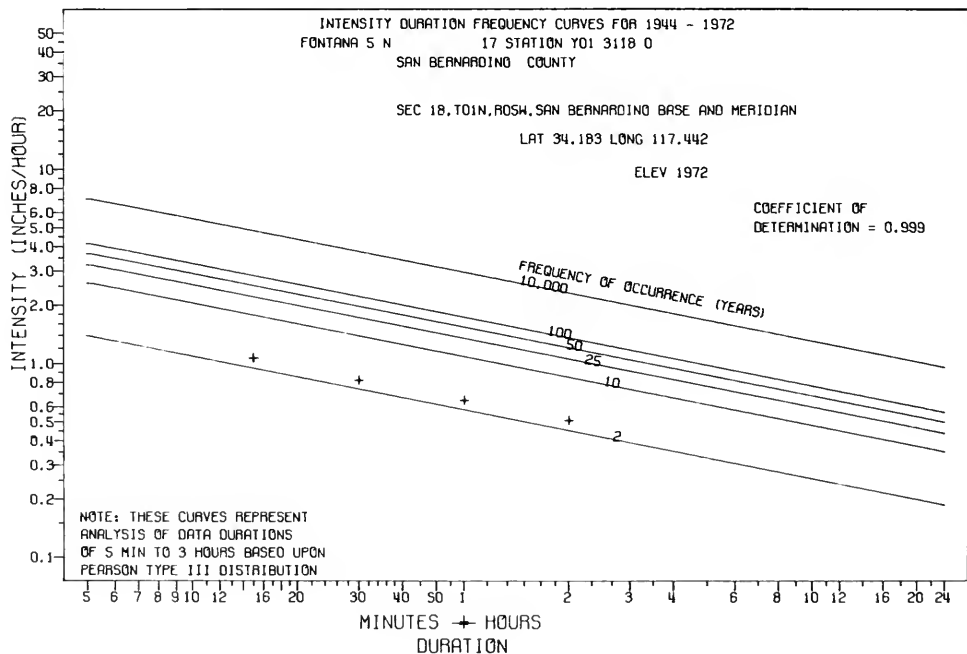
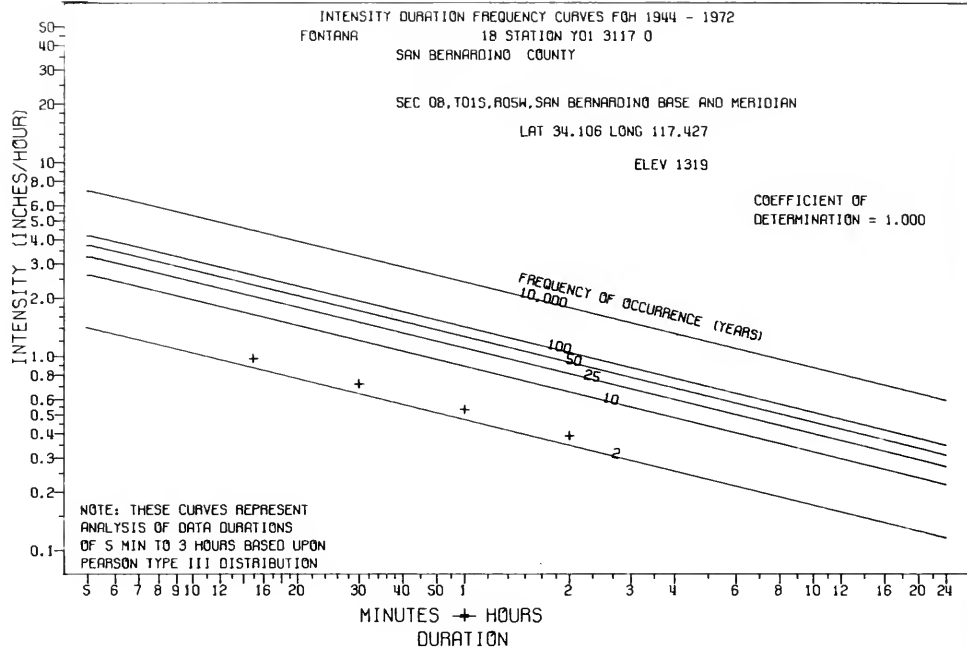
ELEV 980

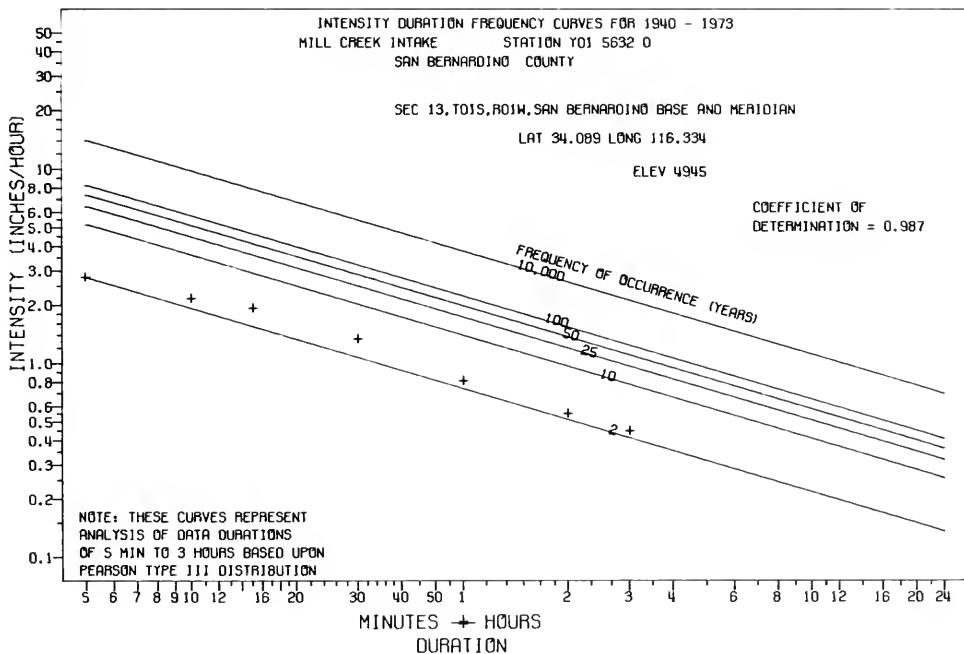
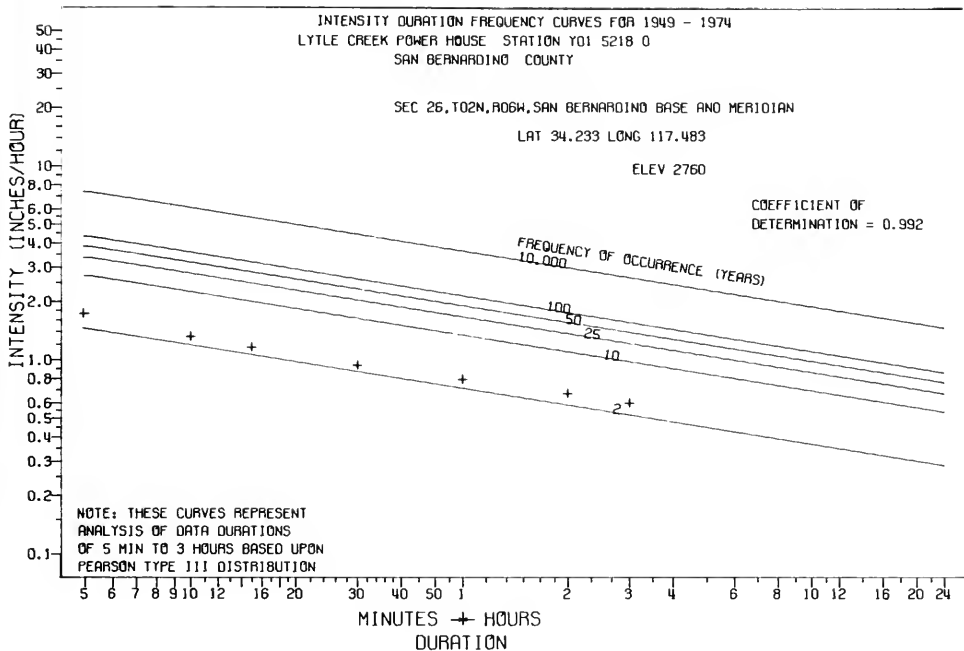
COEFFICIENT OF
DETERMINATION = 1.000

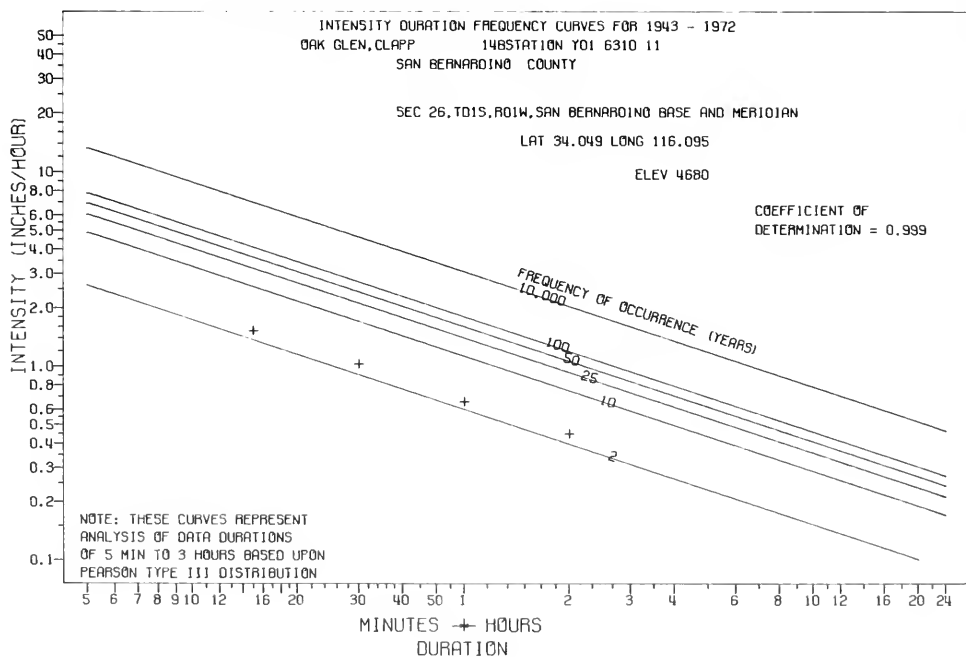
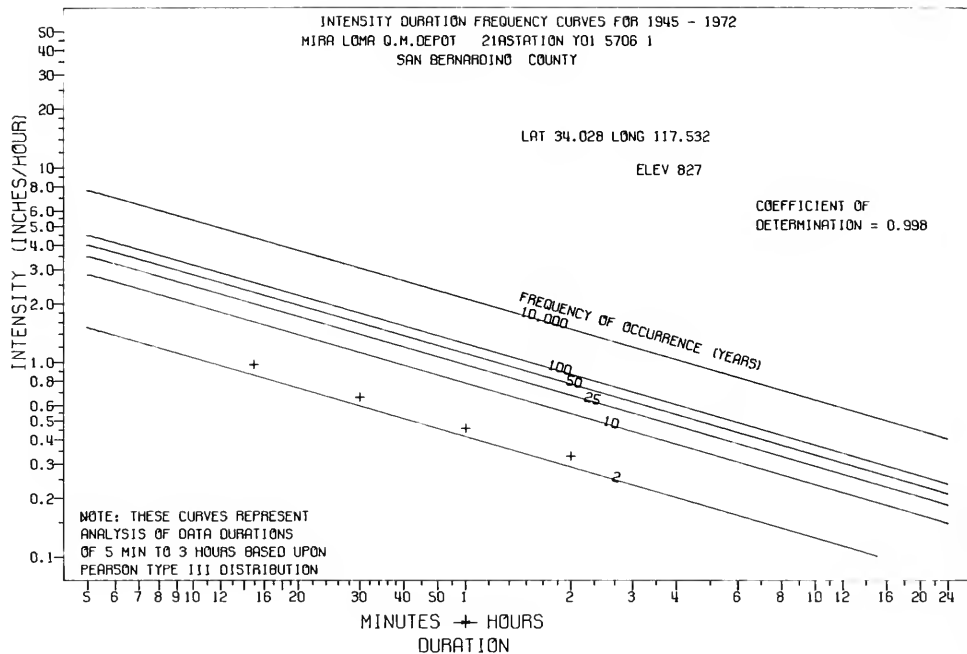


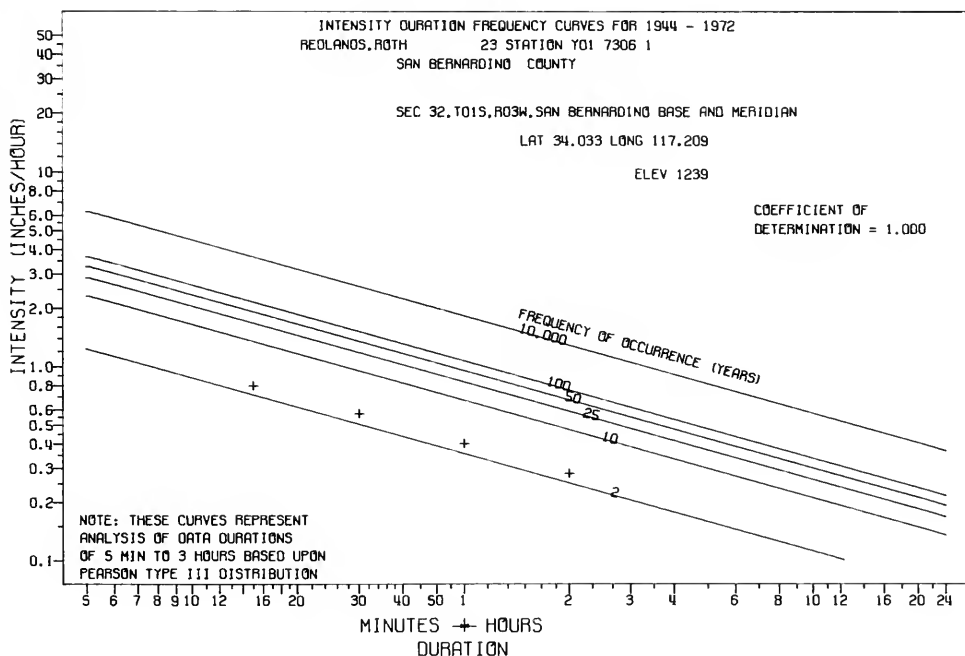
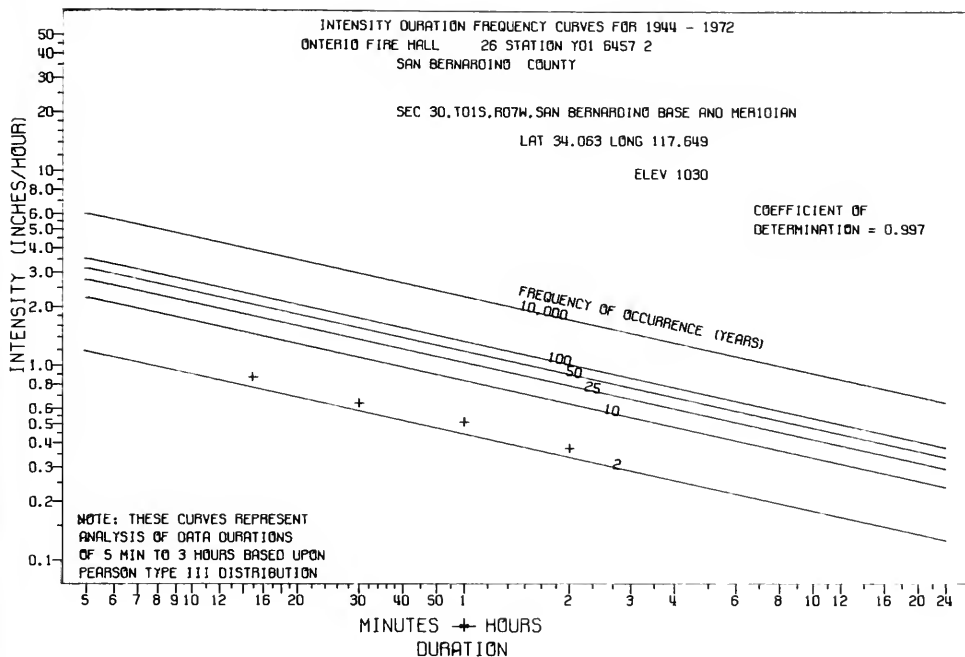


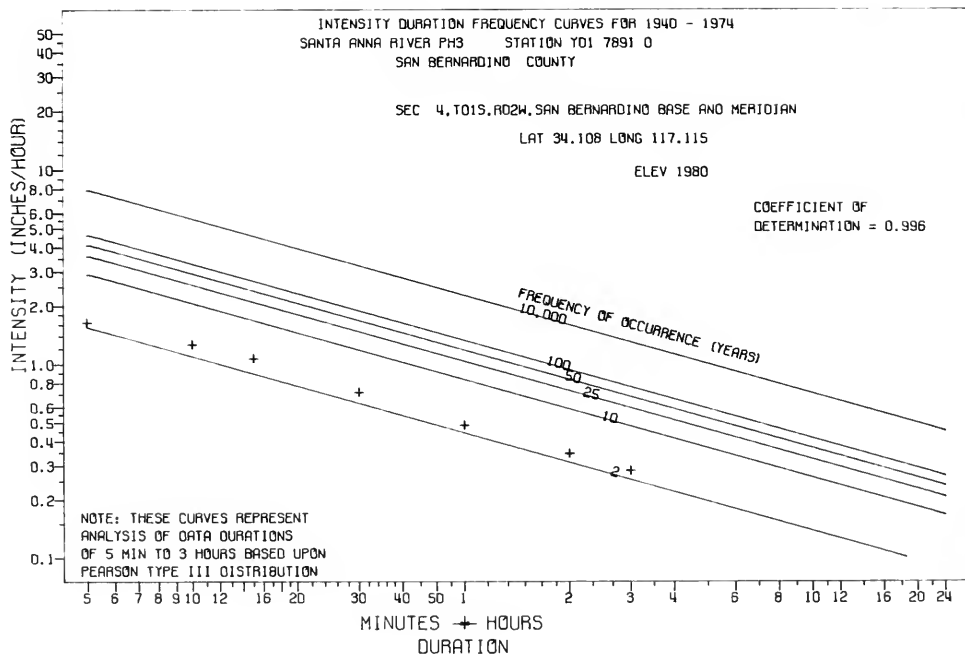
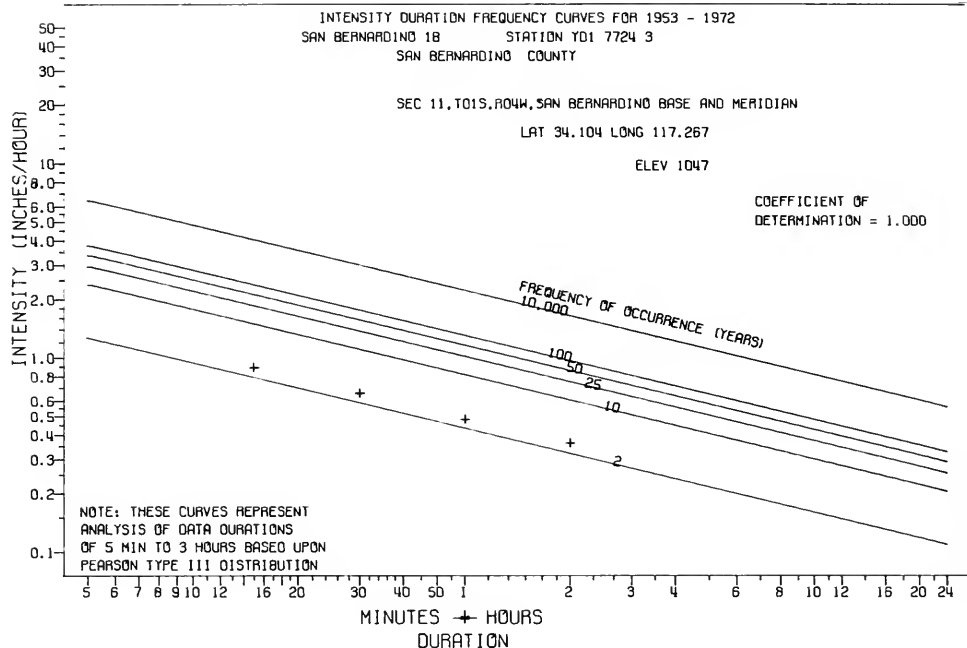


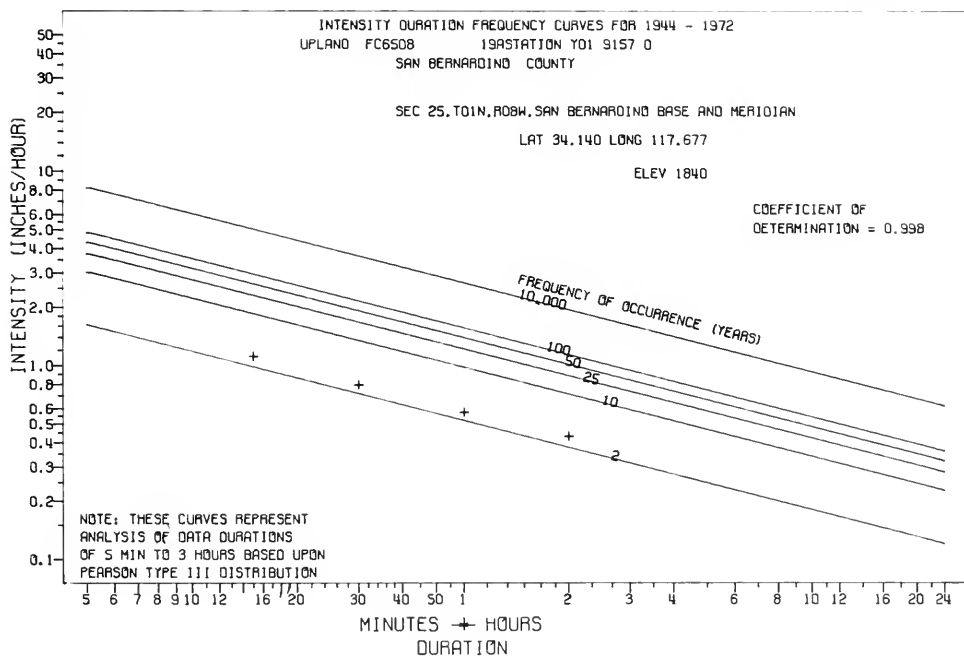
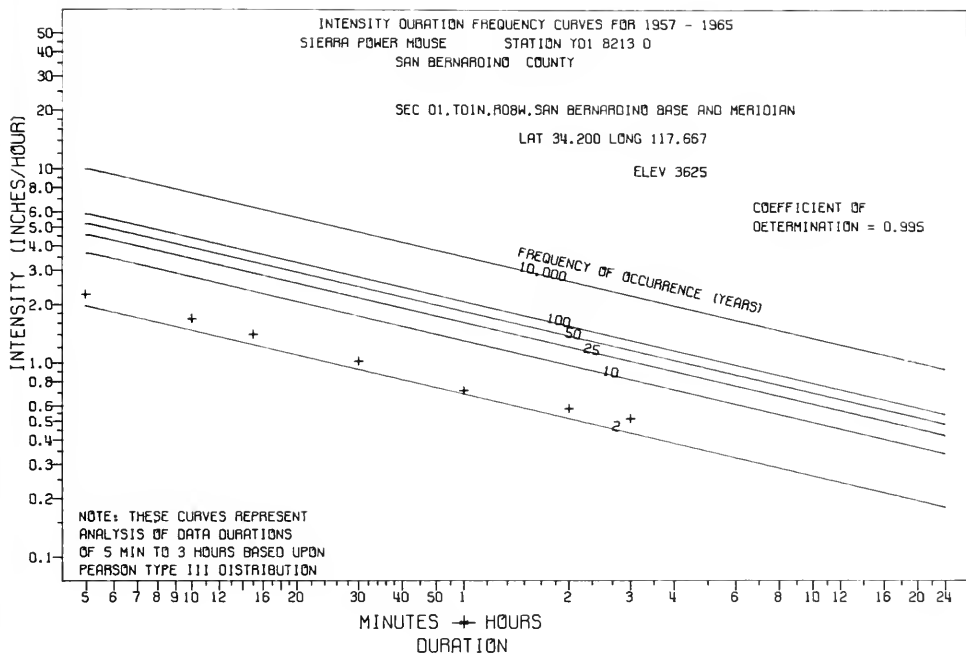


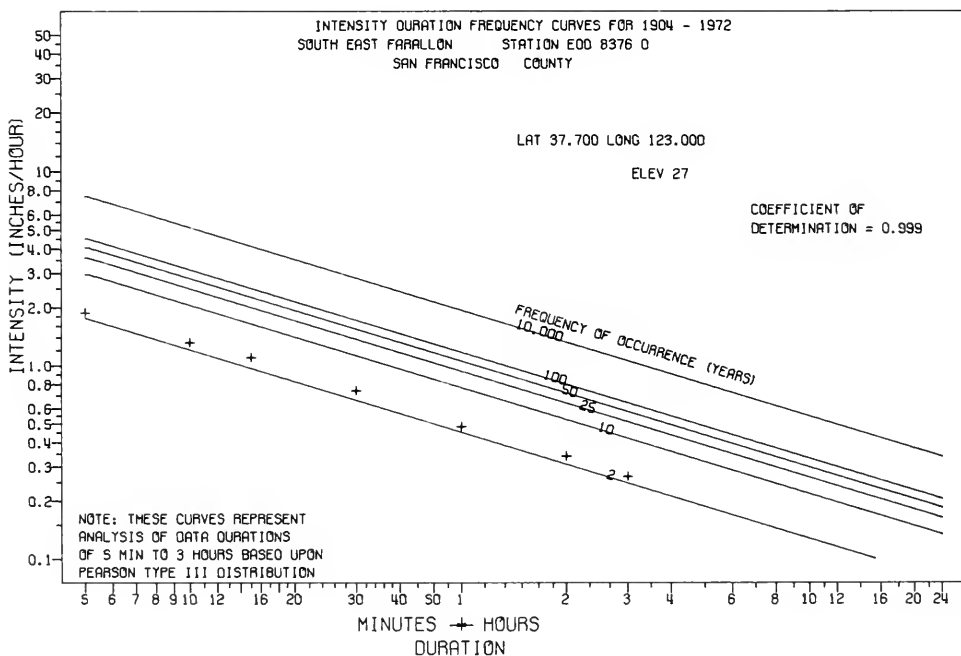
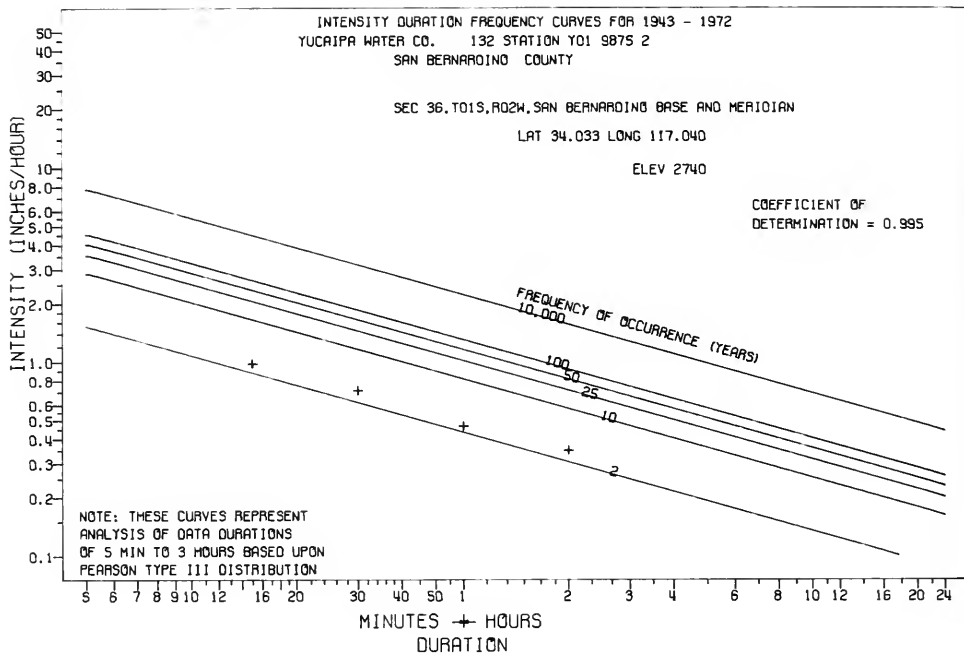


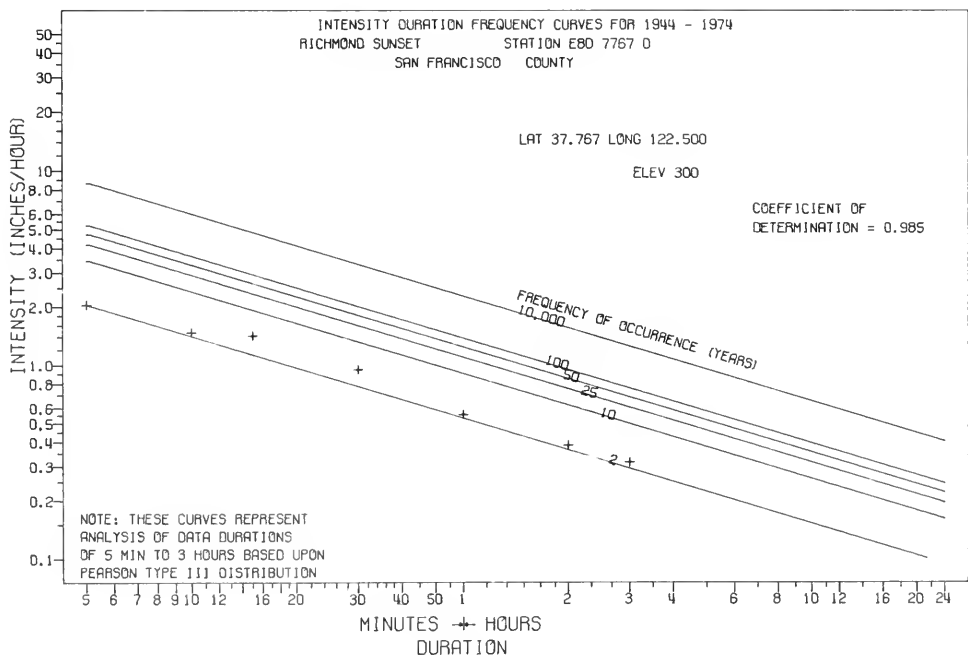
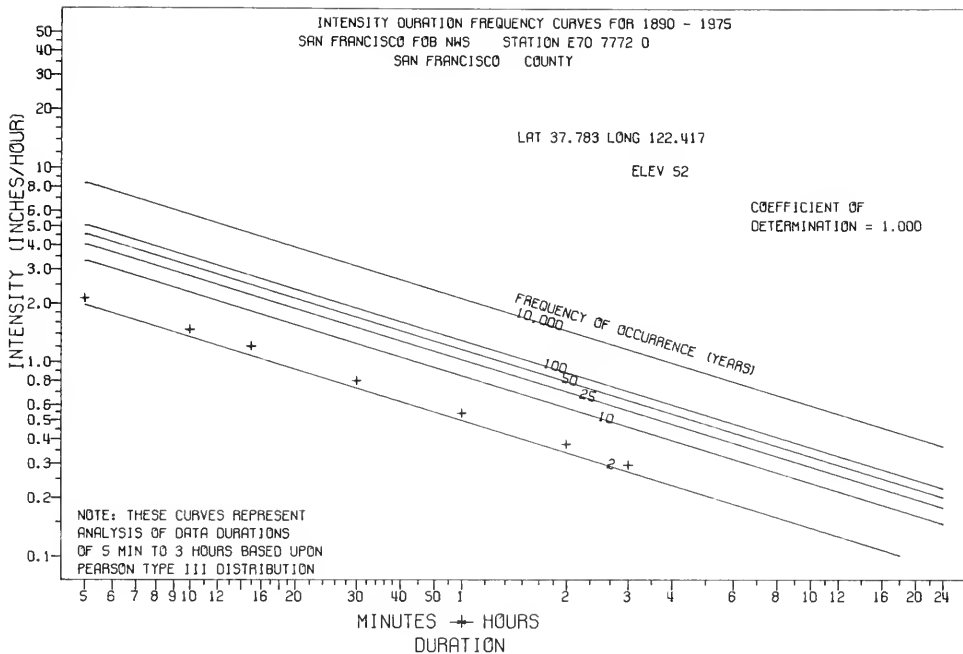


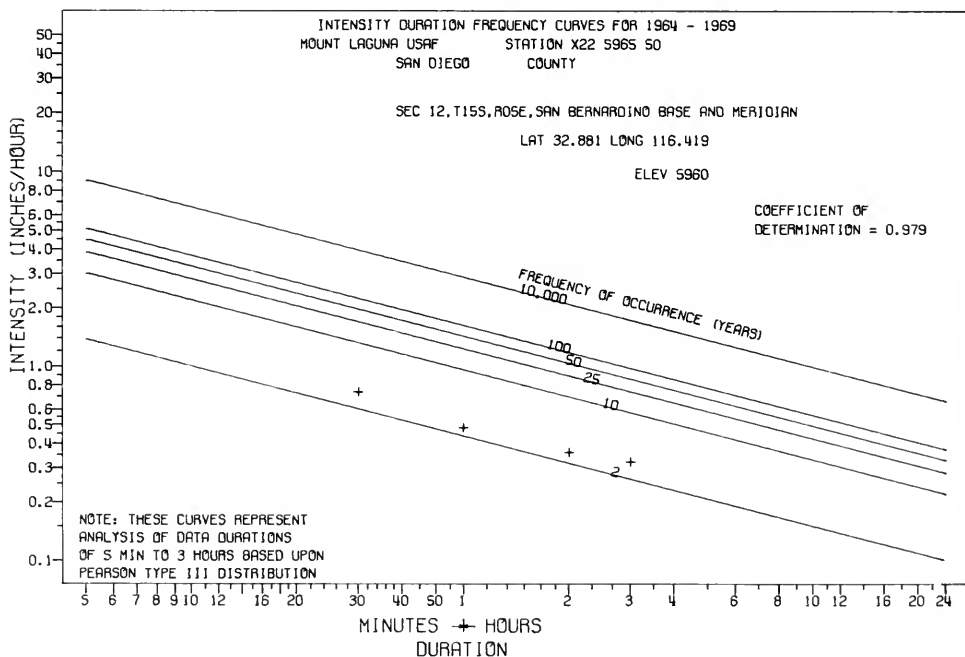
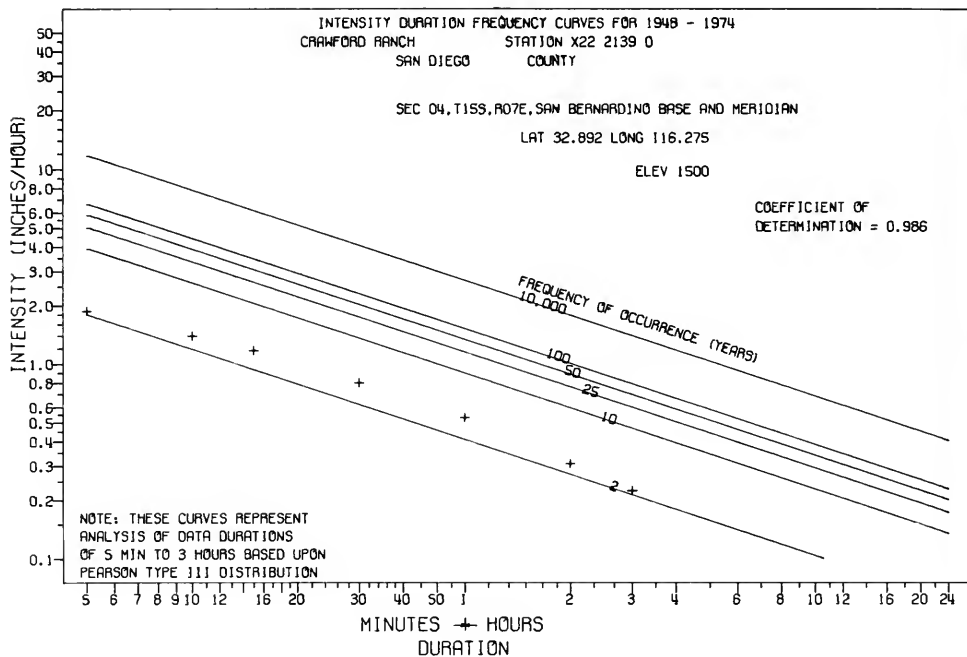


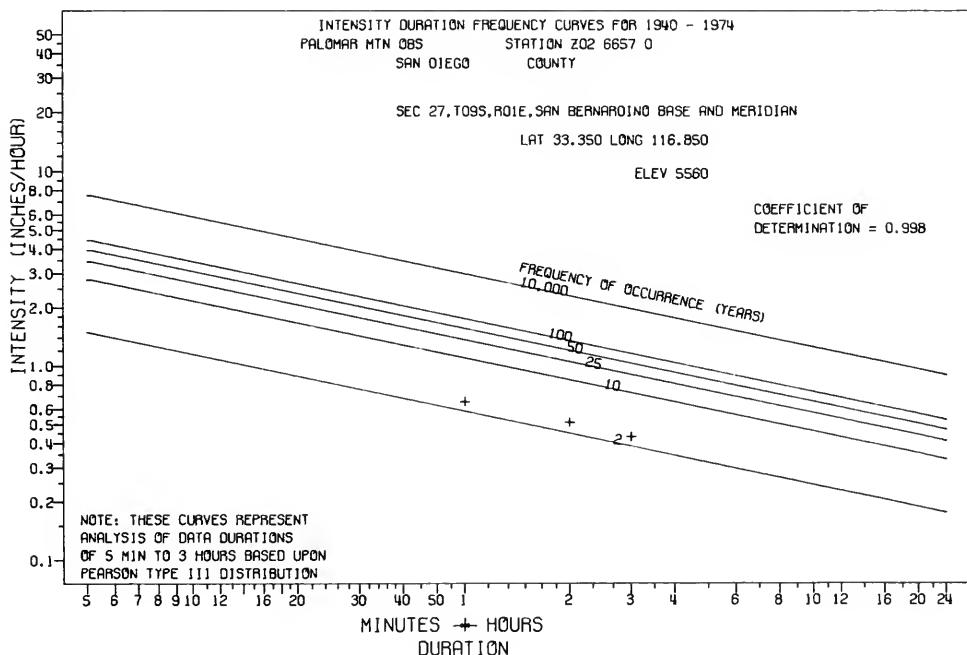
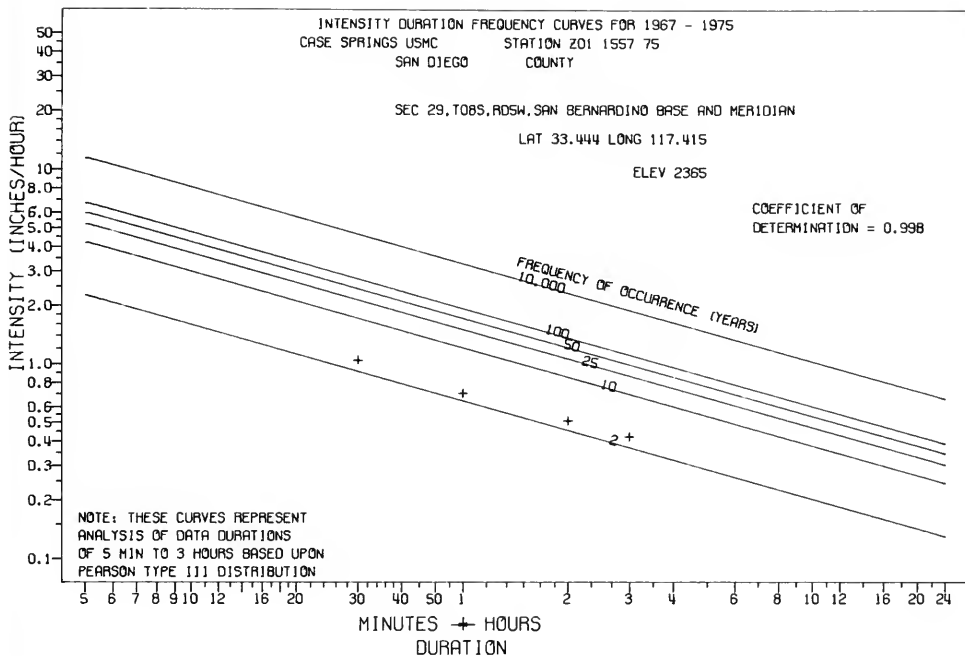


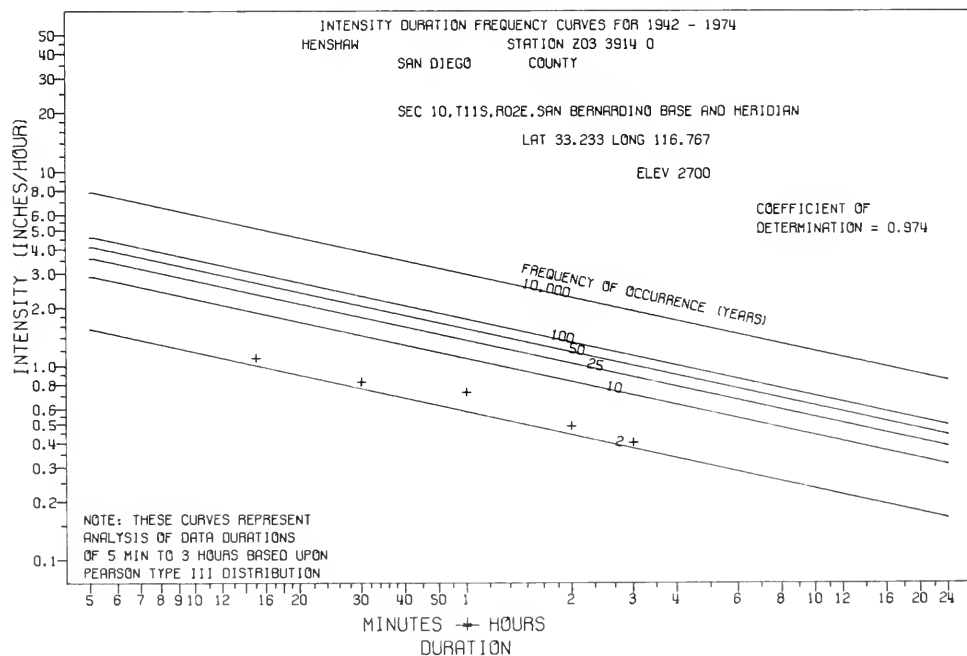
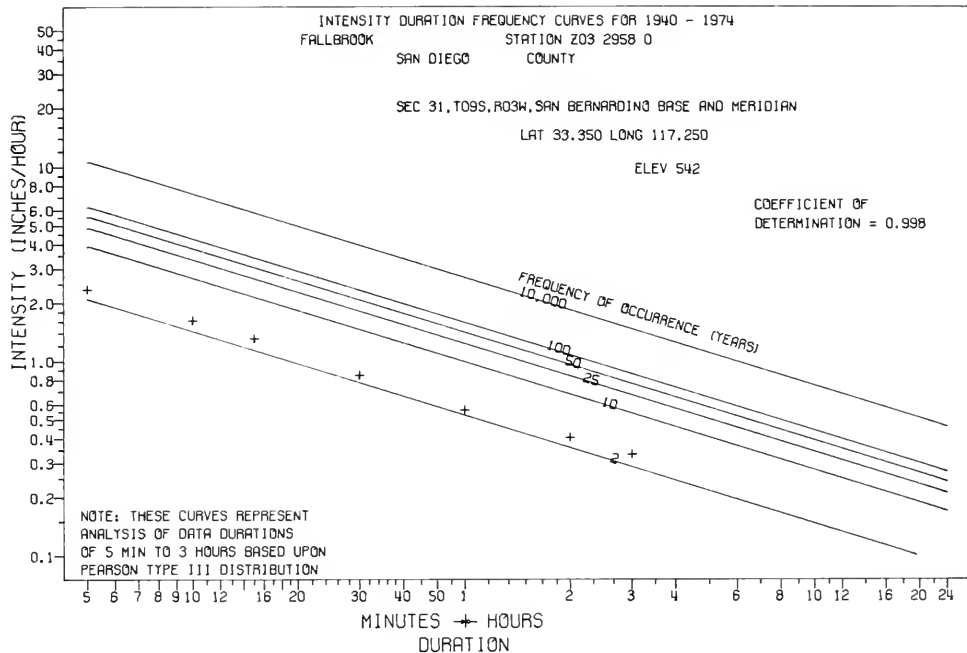


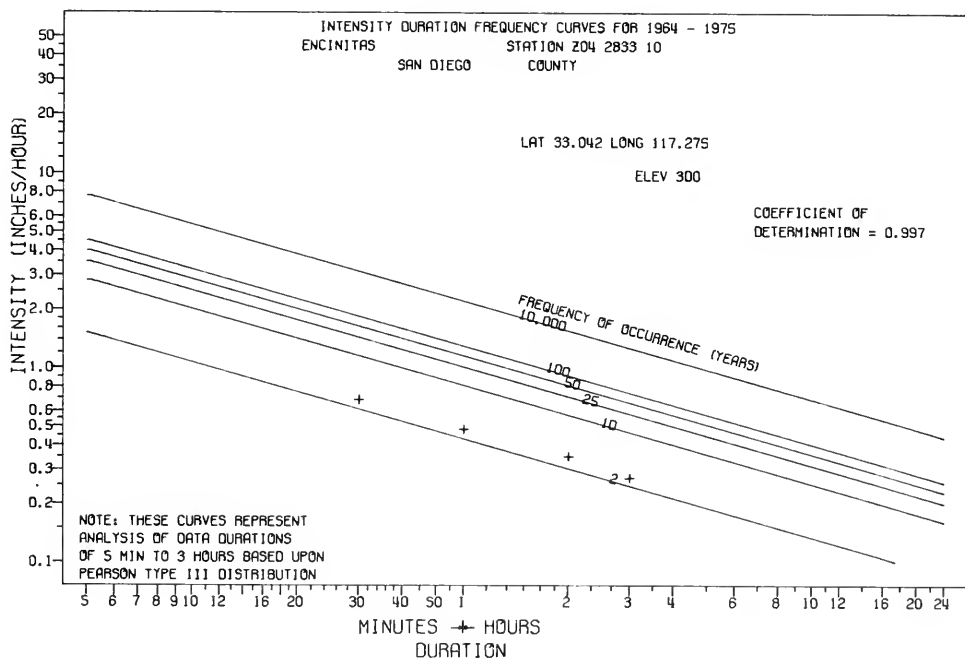
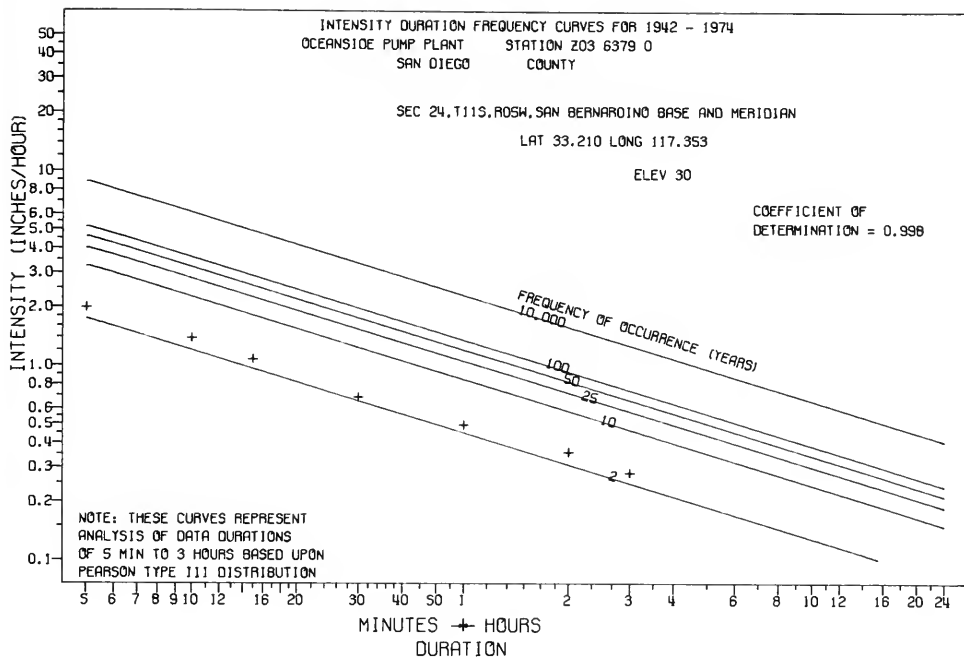


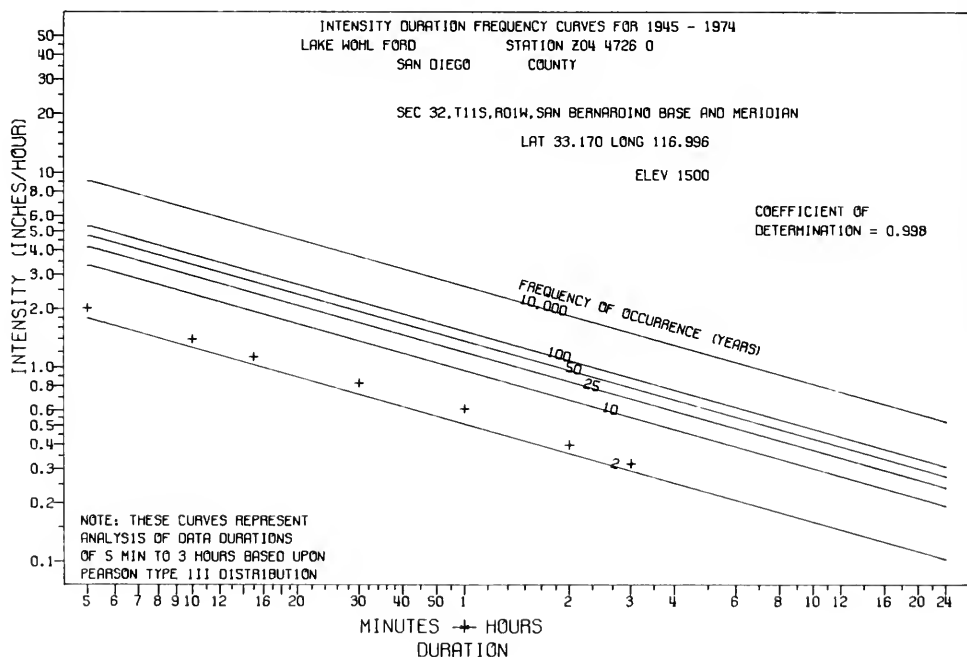
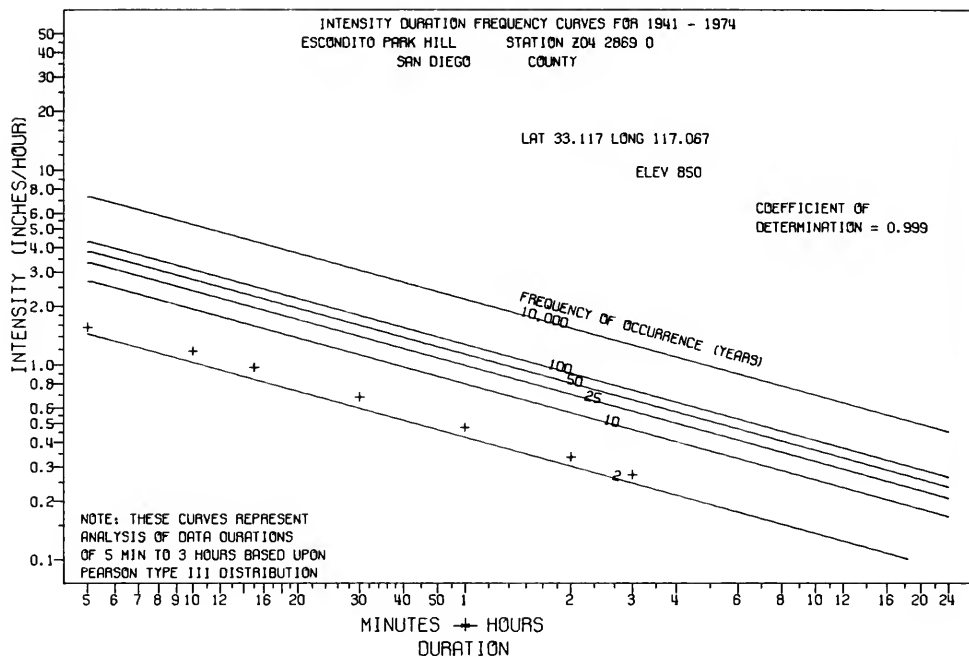


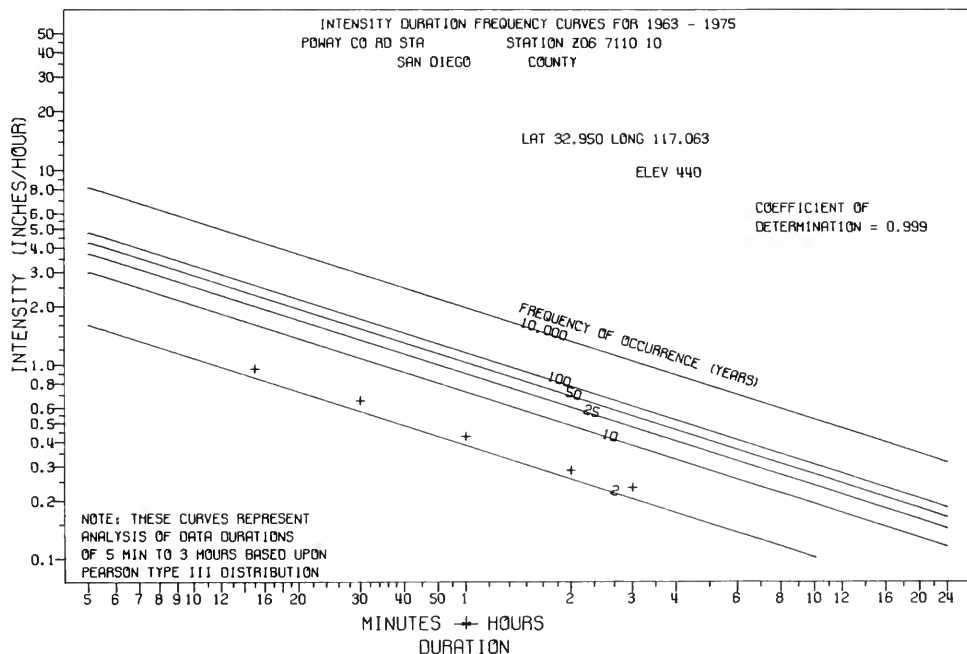
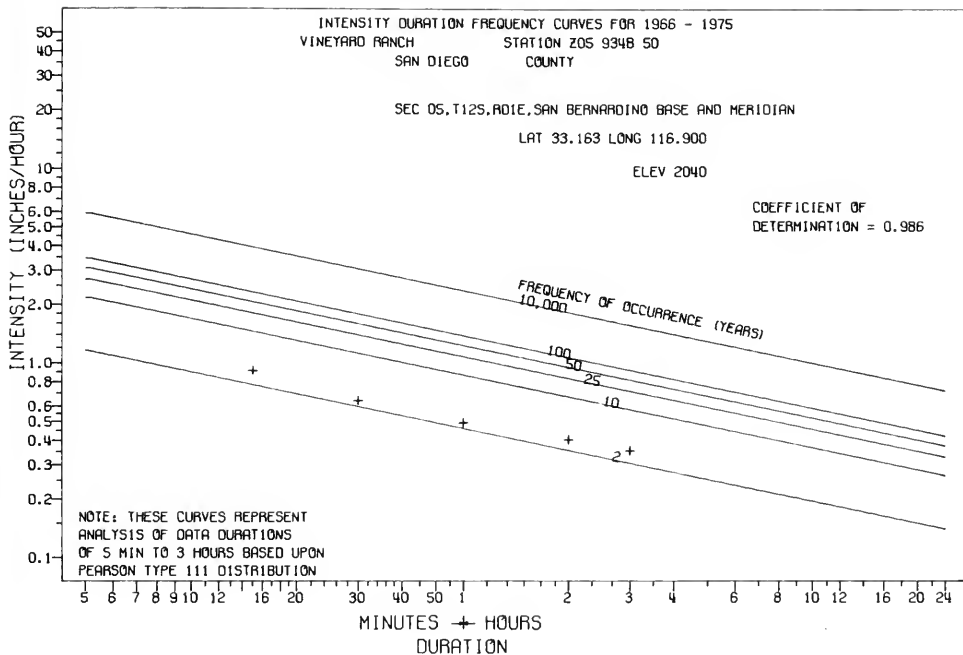












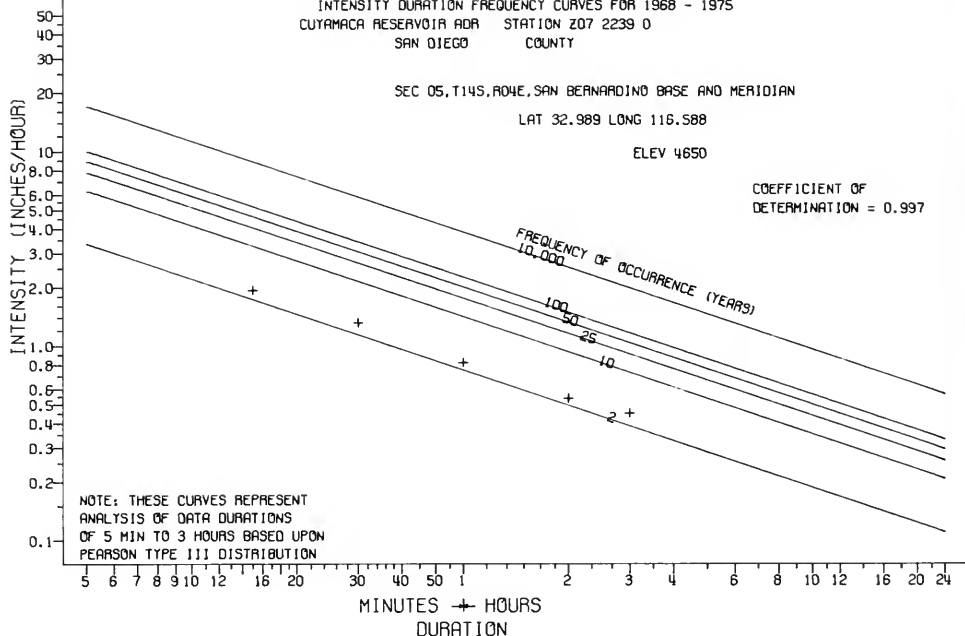
INTENSITY DURATION FREQUENCY CURVES FOR 1968 - 1975
CUTAMACA RESERVOIR ADR STATION Z07 2239 0
SAN DIEGO COUNTY

SEC 05, T14S, R04E, SAN BERNARDINO BASE AND MERIDIAN

LAT 32.989 LONG 116.588

ELEV 4650

COEFFICIENT OF
DETERMINATION = 0.997



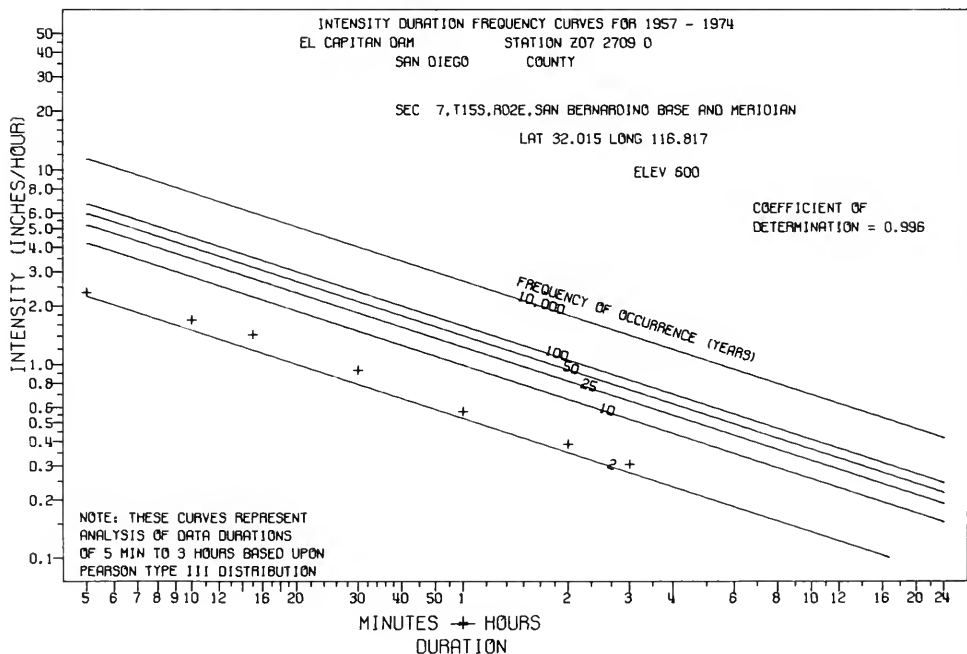
INTENSITY DURATION FREQUENCY CURVES FOR 1957 - 1974
EL CAPITAN DAM STATION Z07 2709 0
SAN DIEGO COUNTY

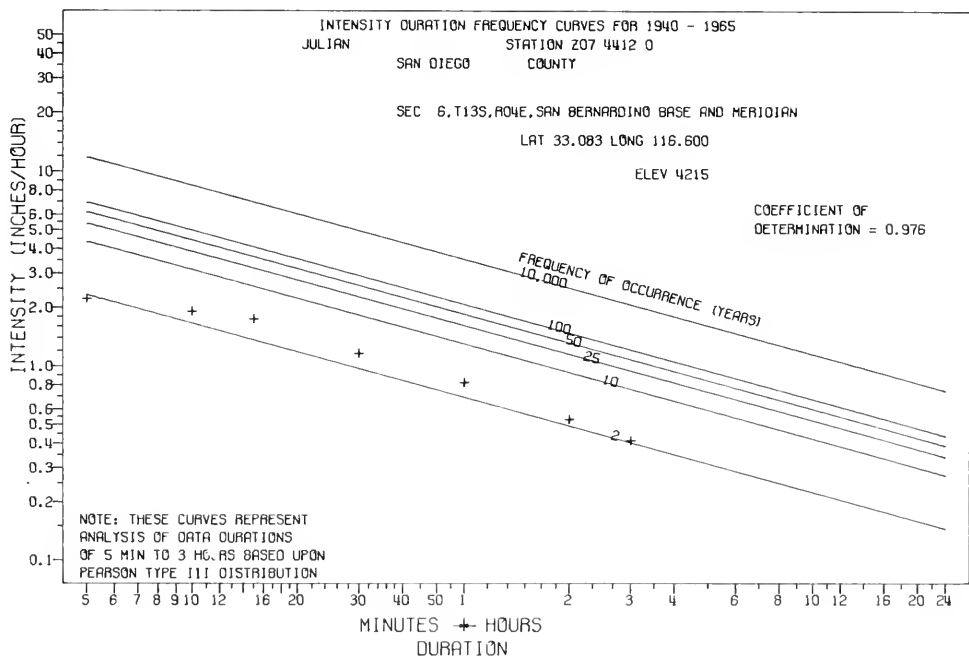
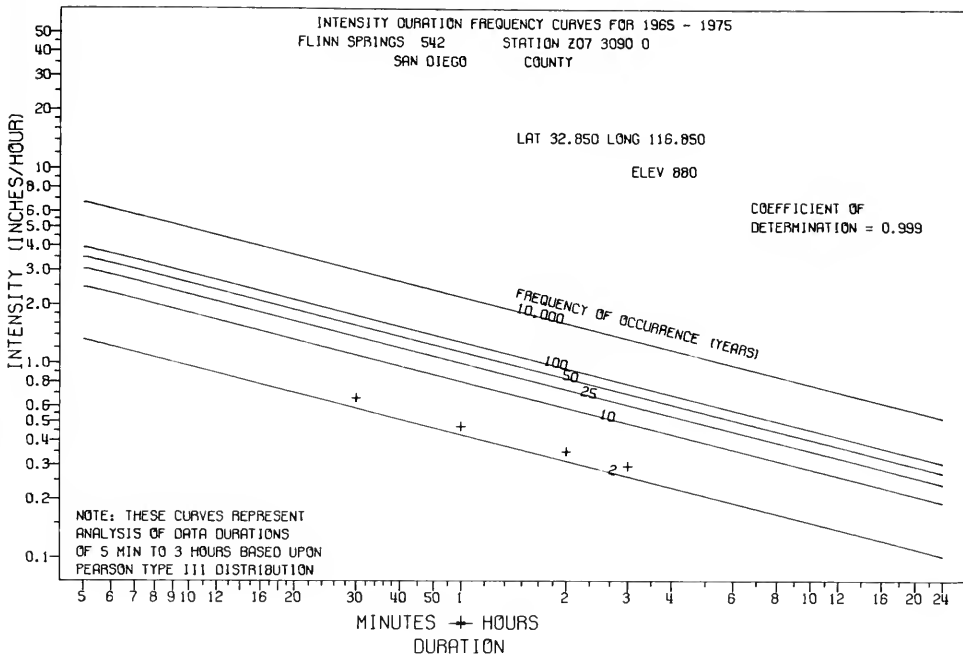
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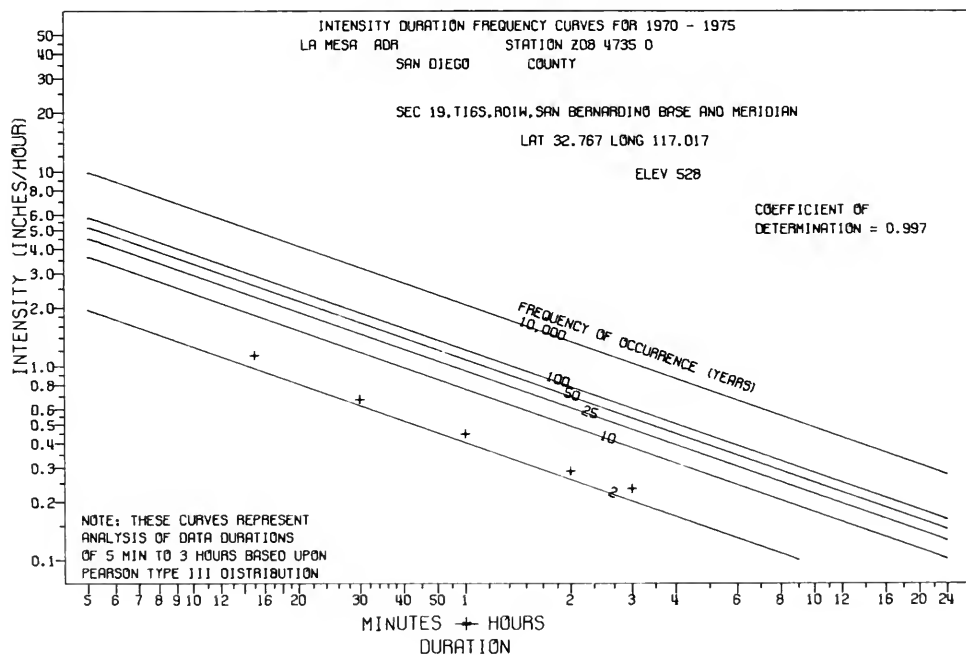
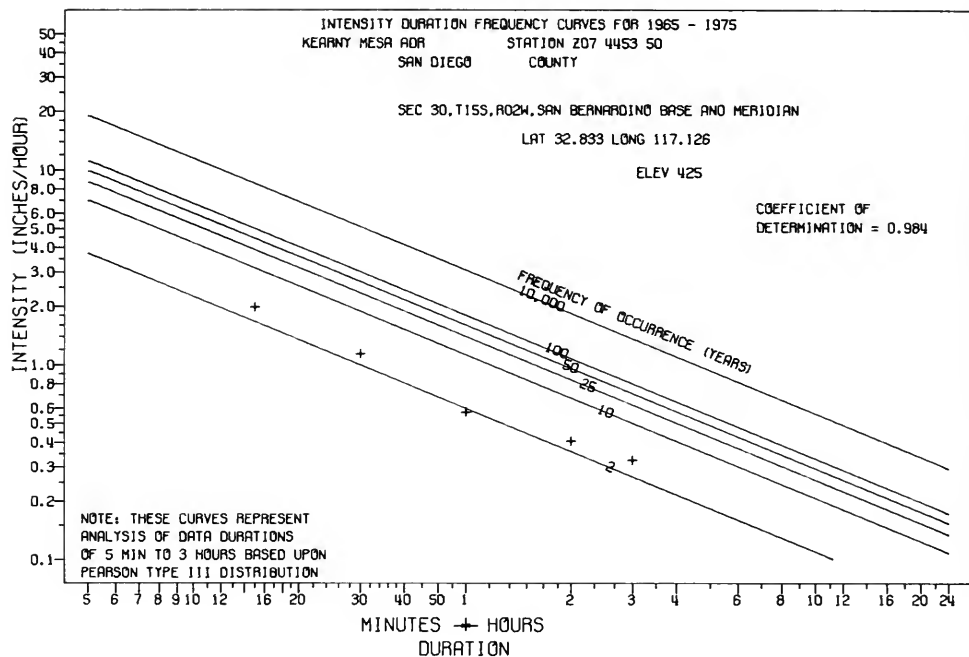
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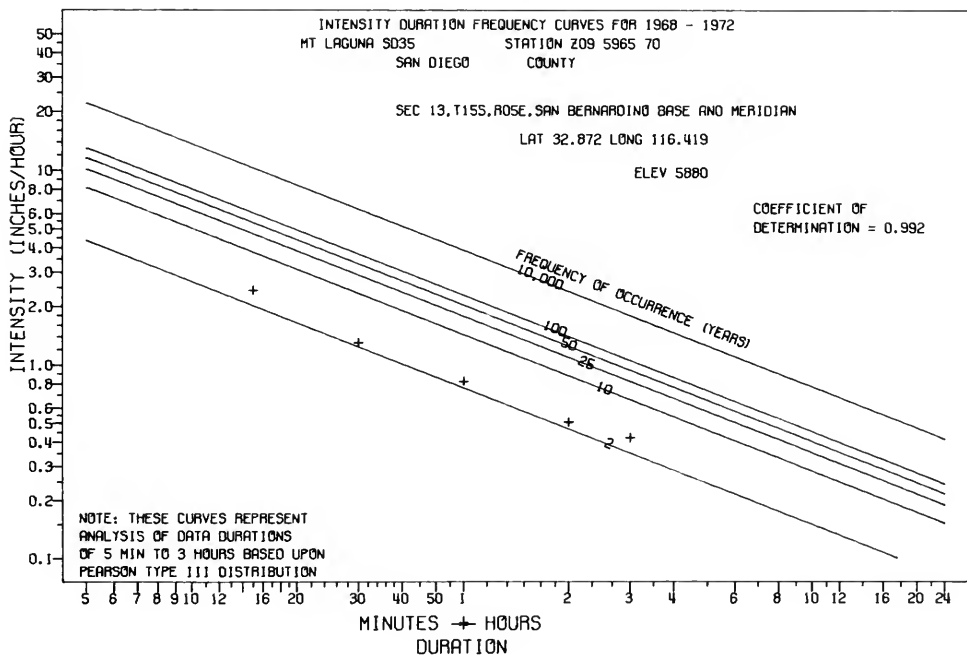
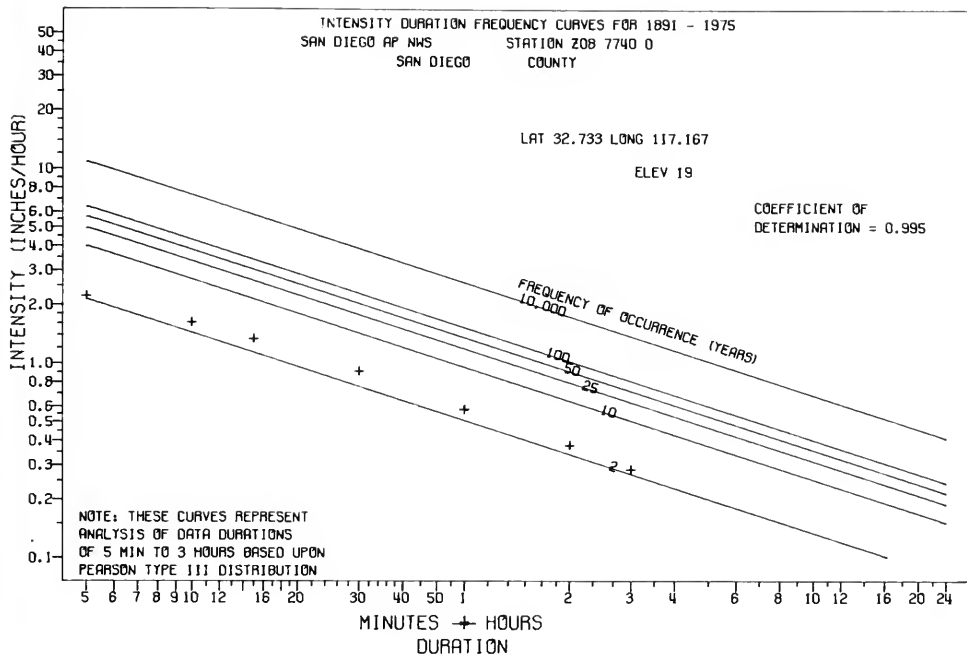
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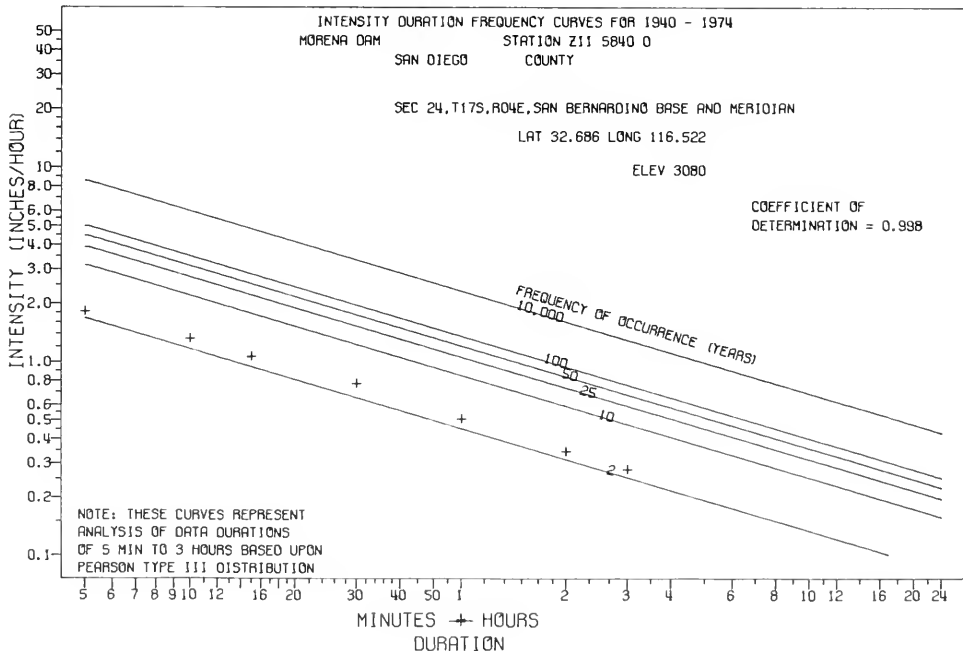
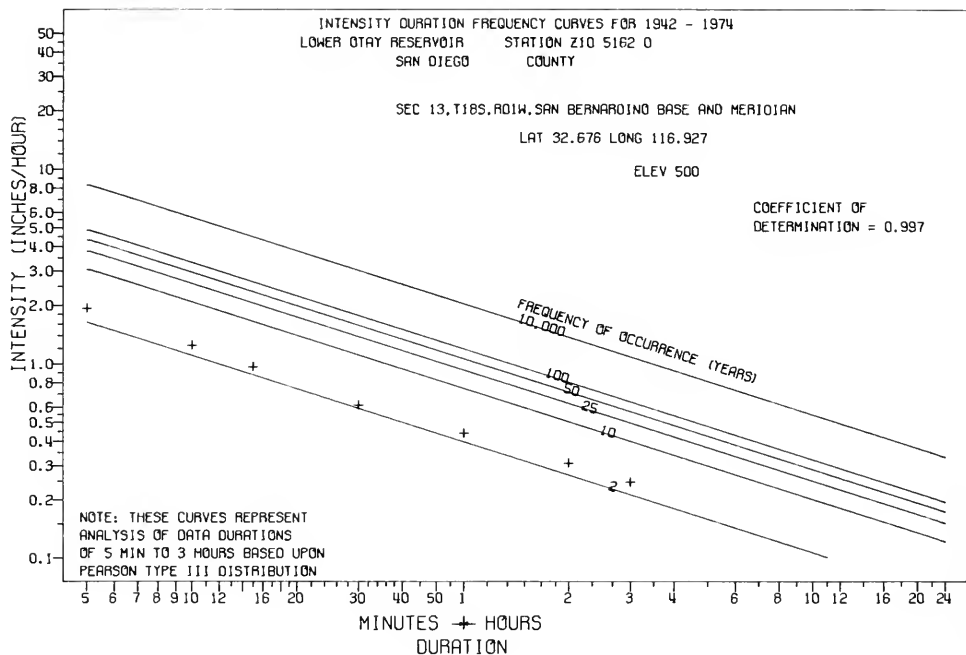
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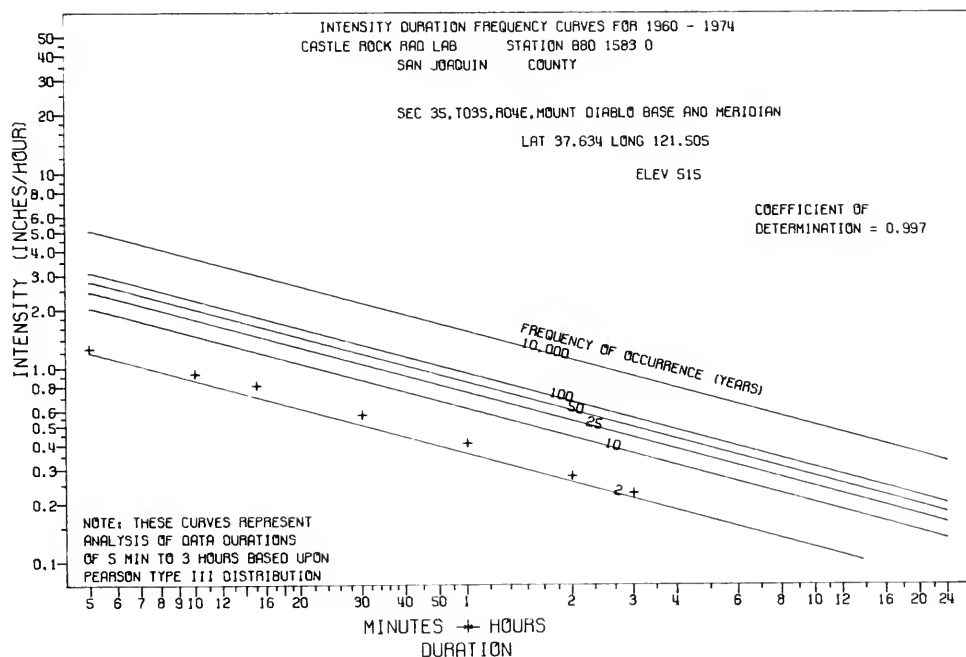
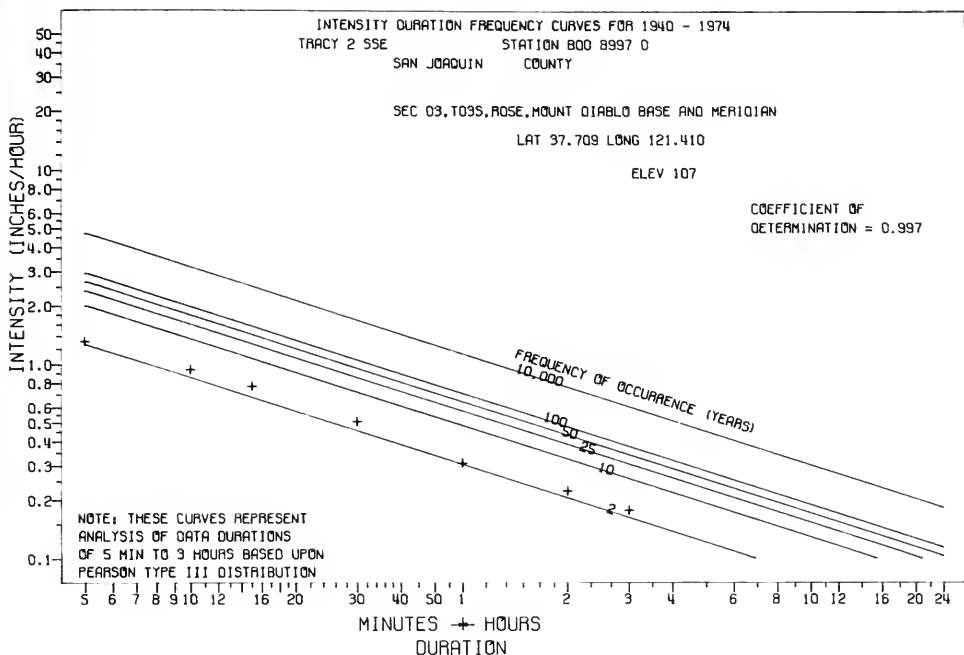


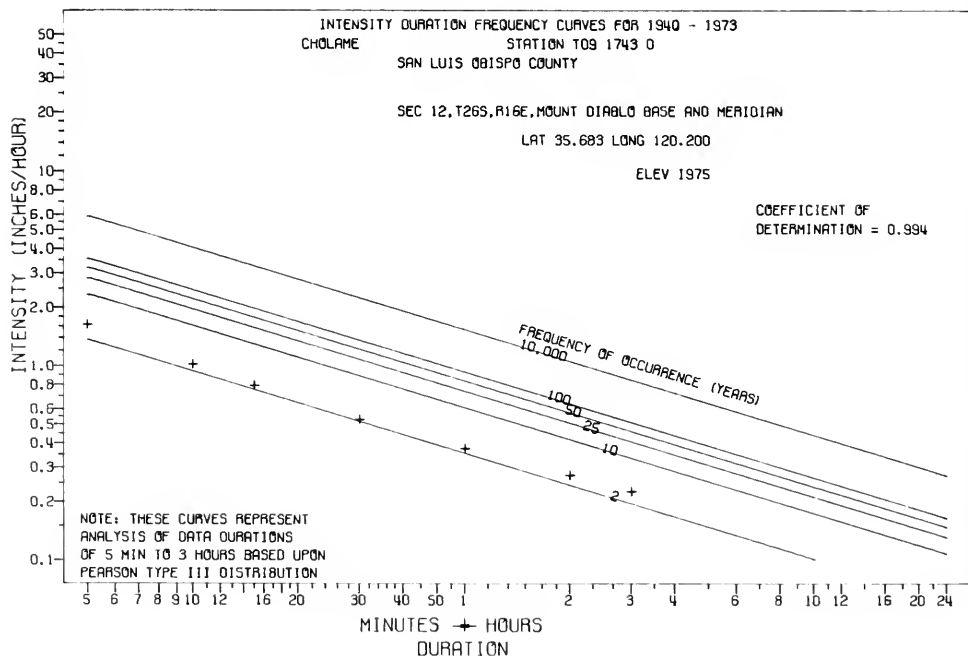
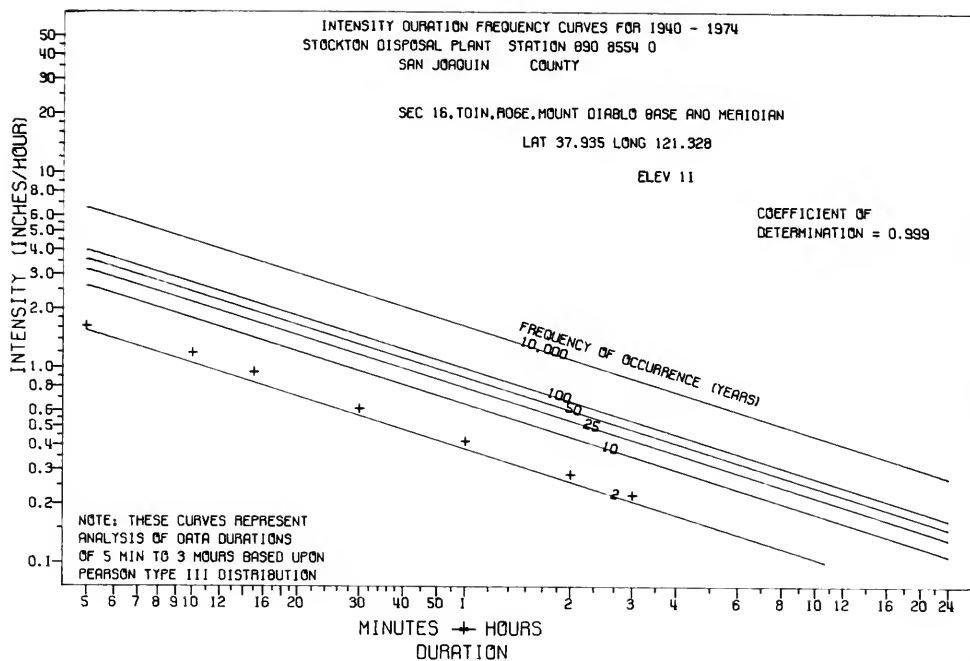


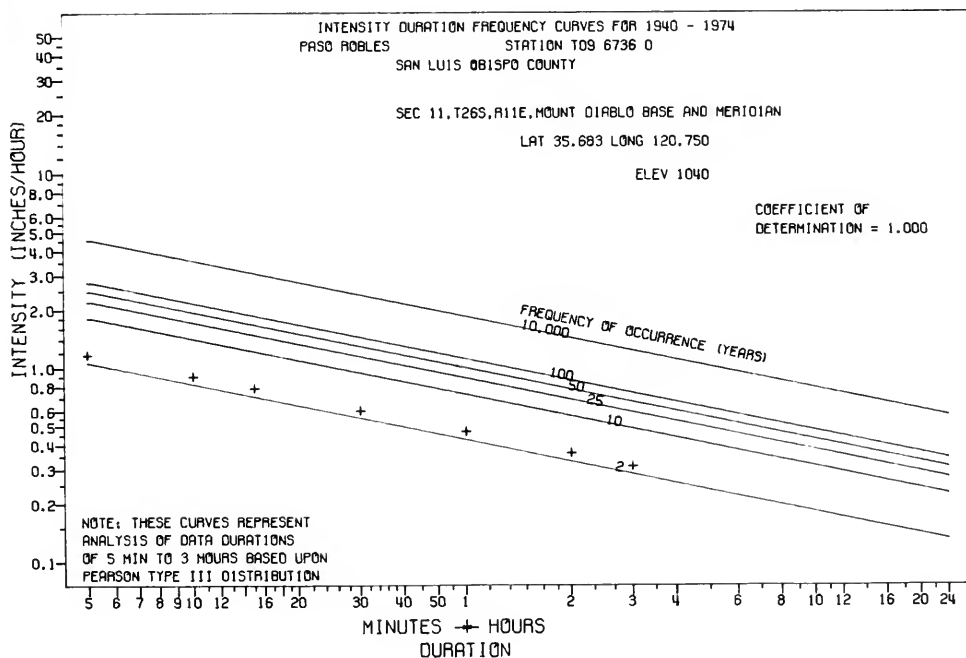
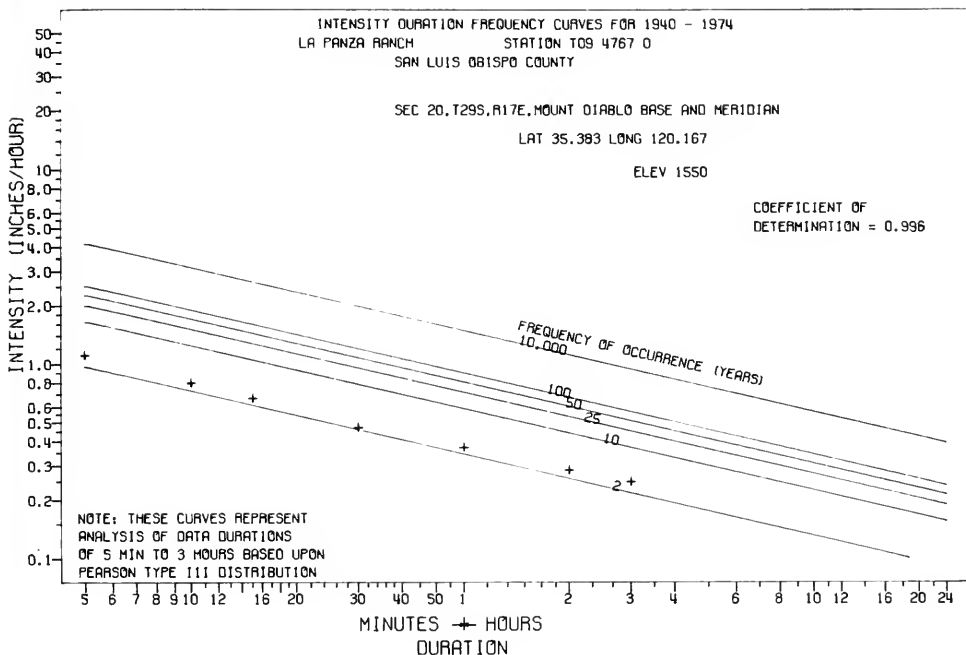


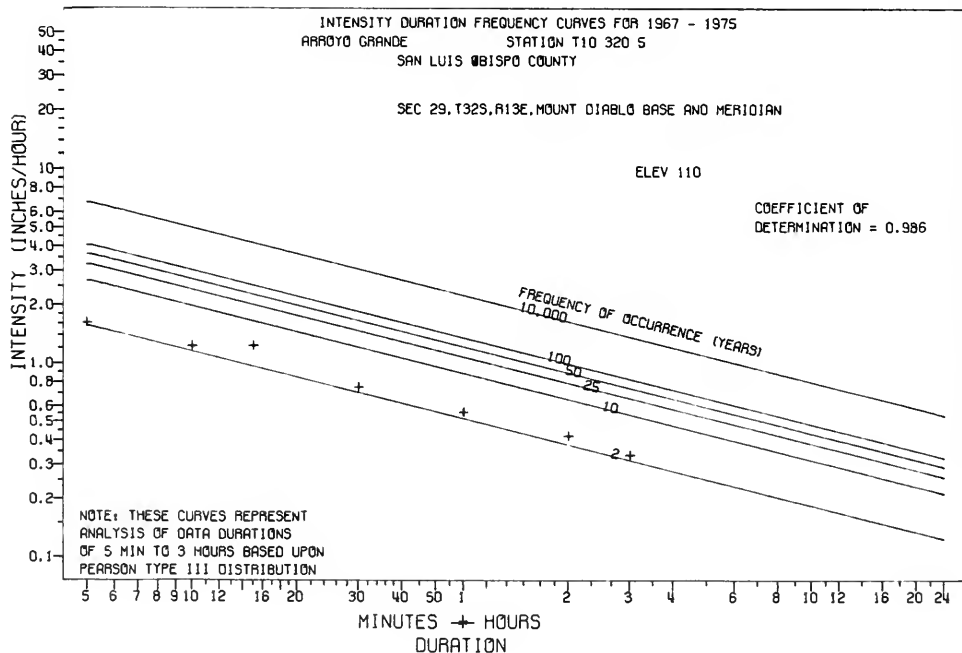
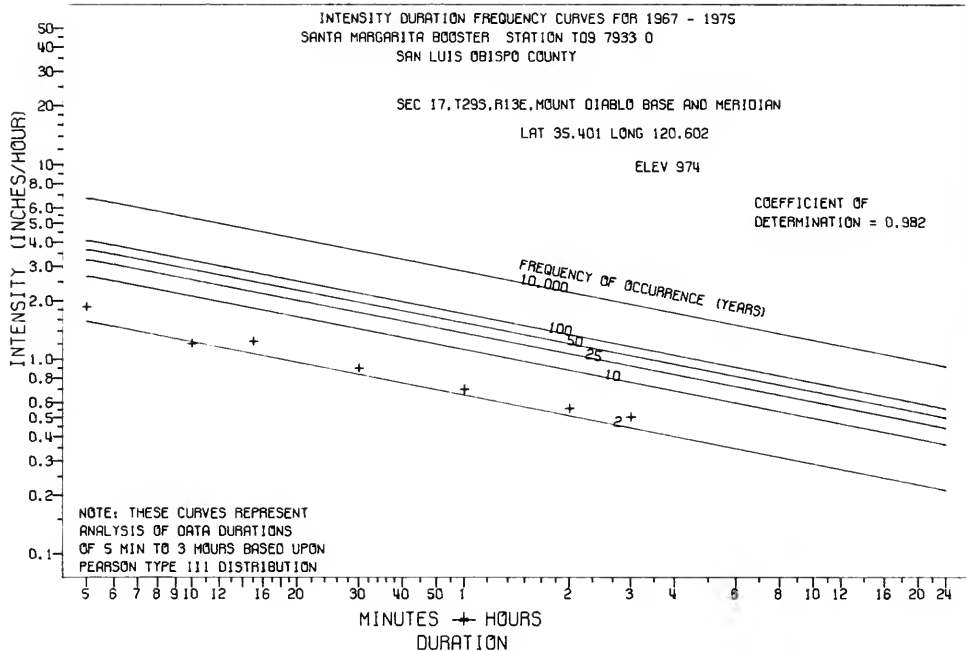


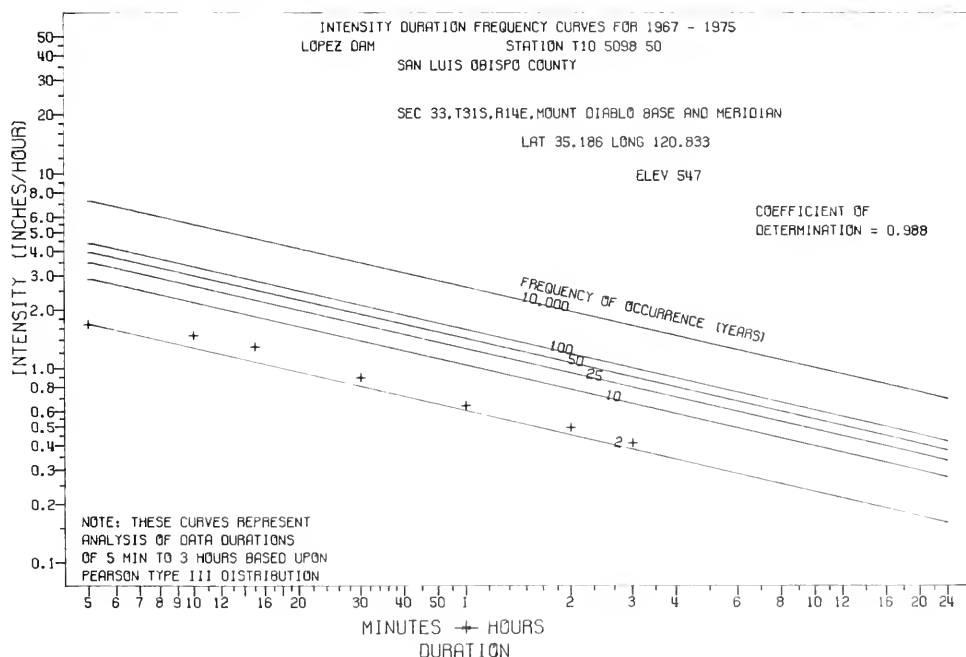
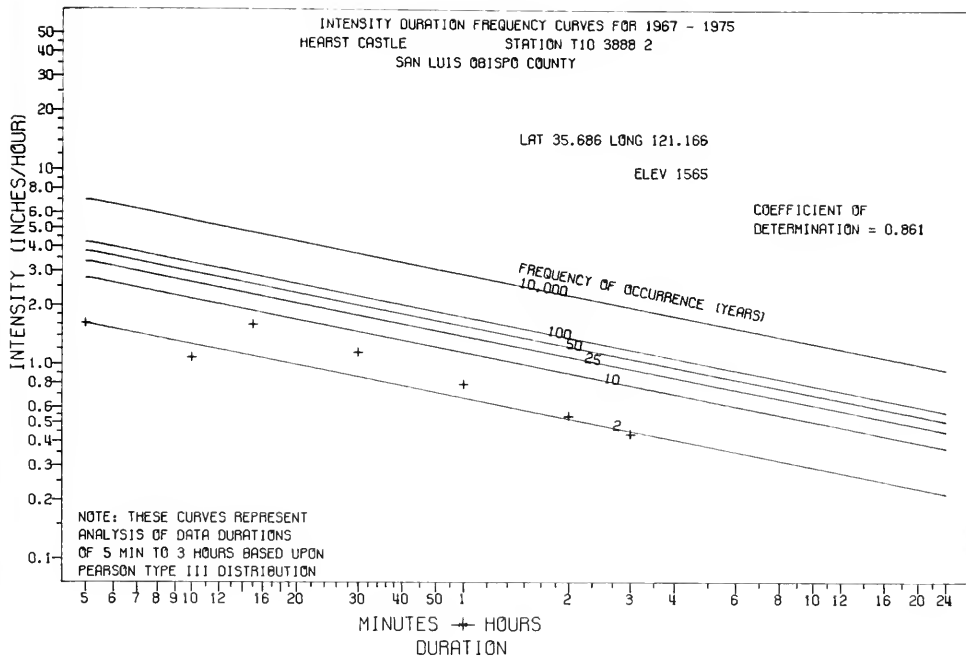


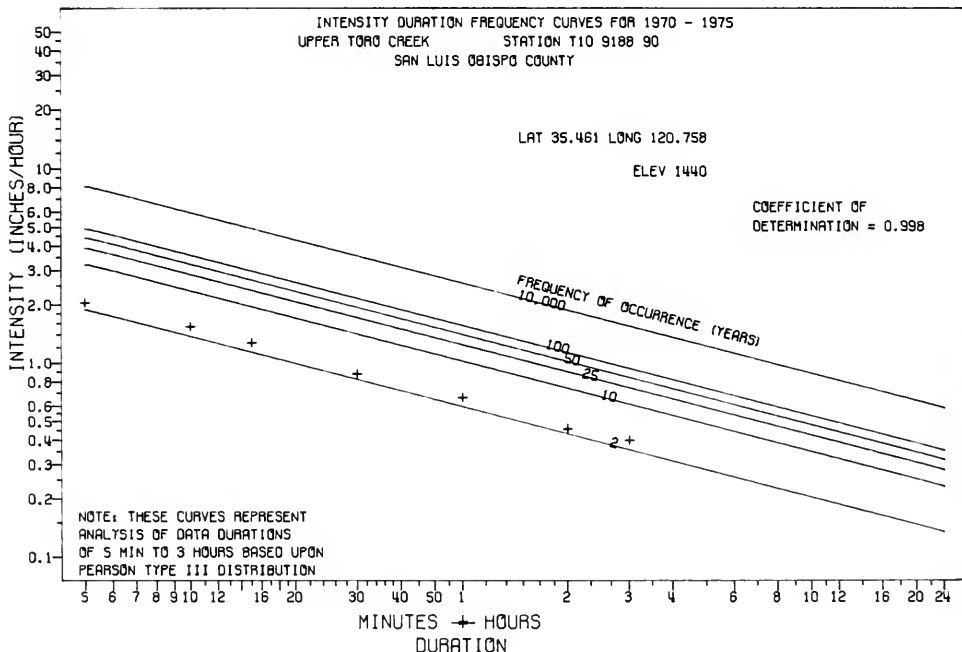
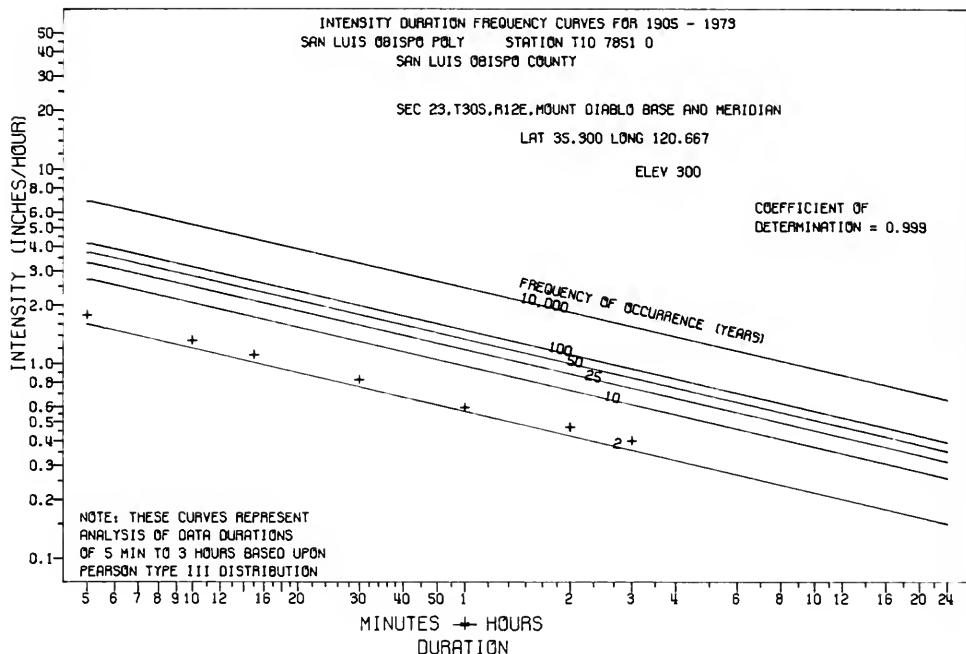


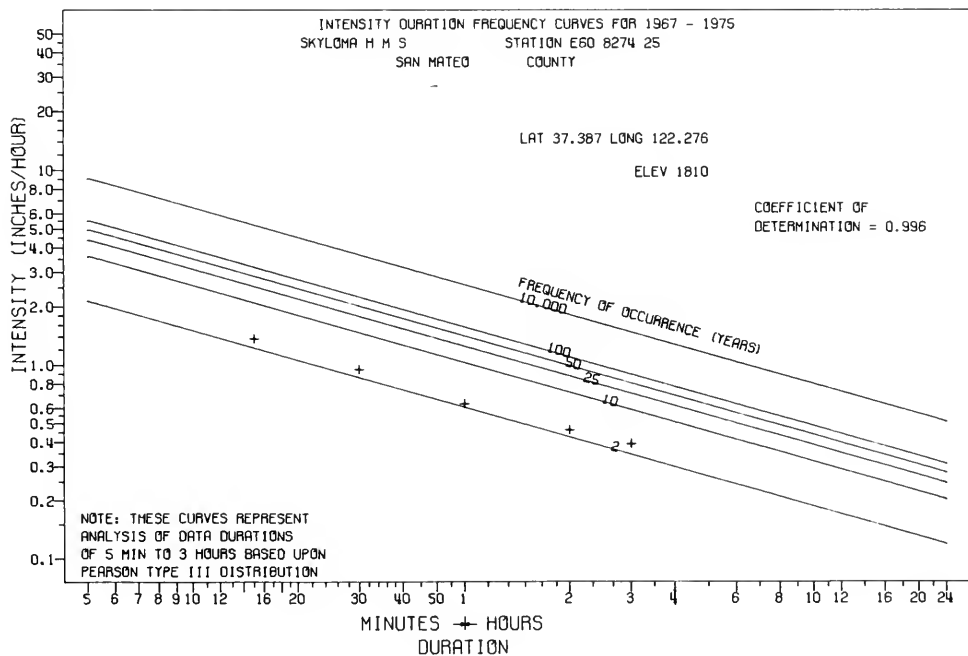
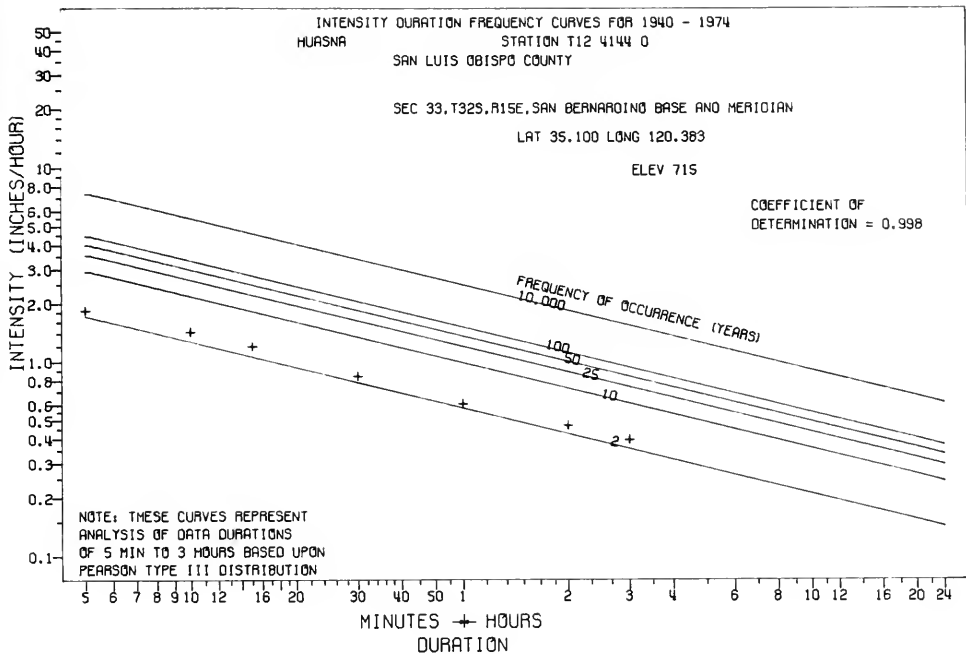


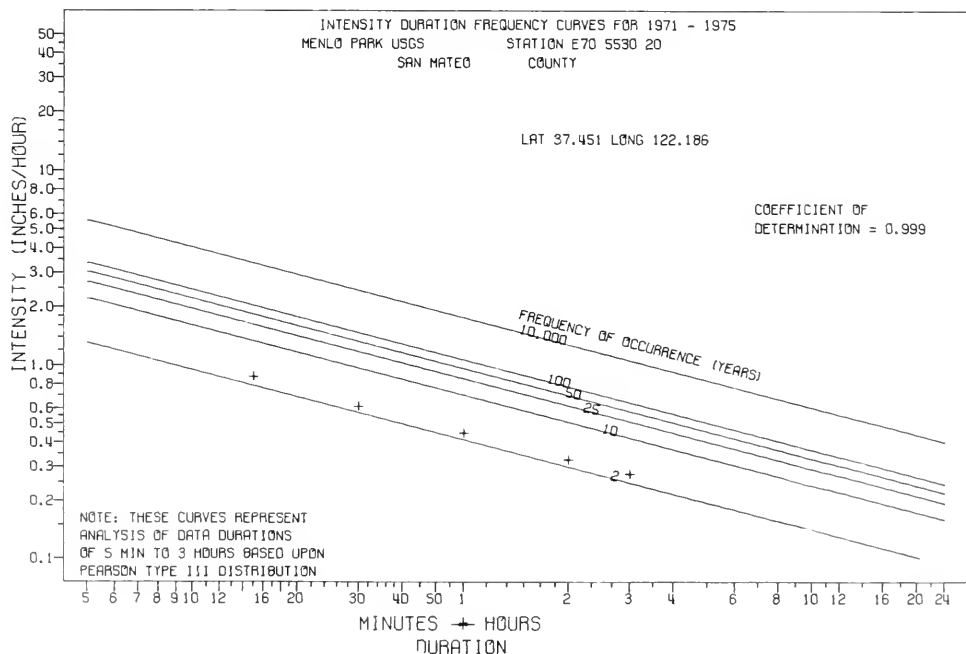
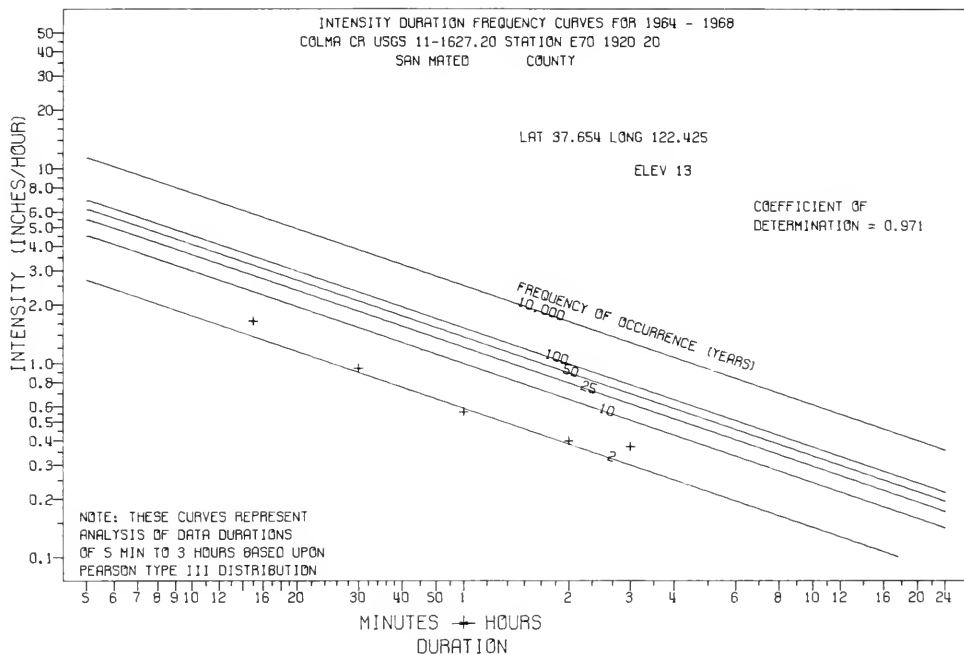


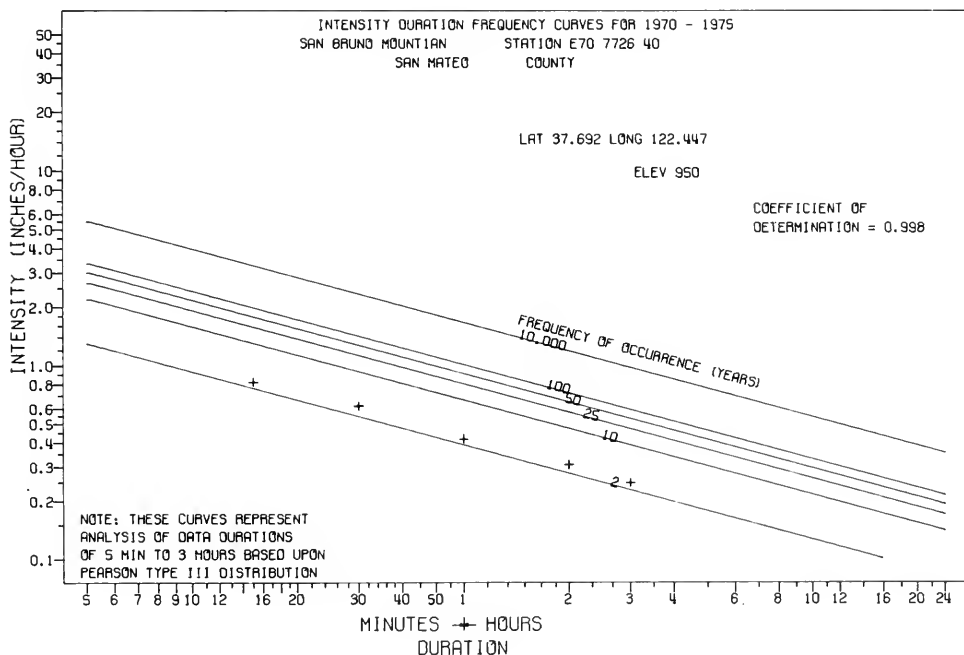
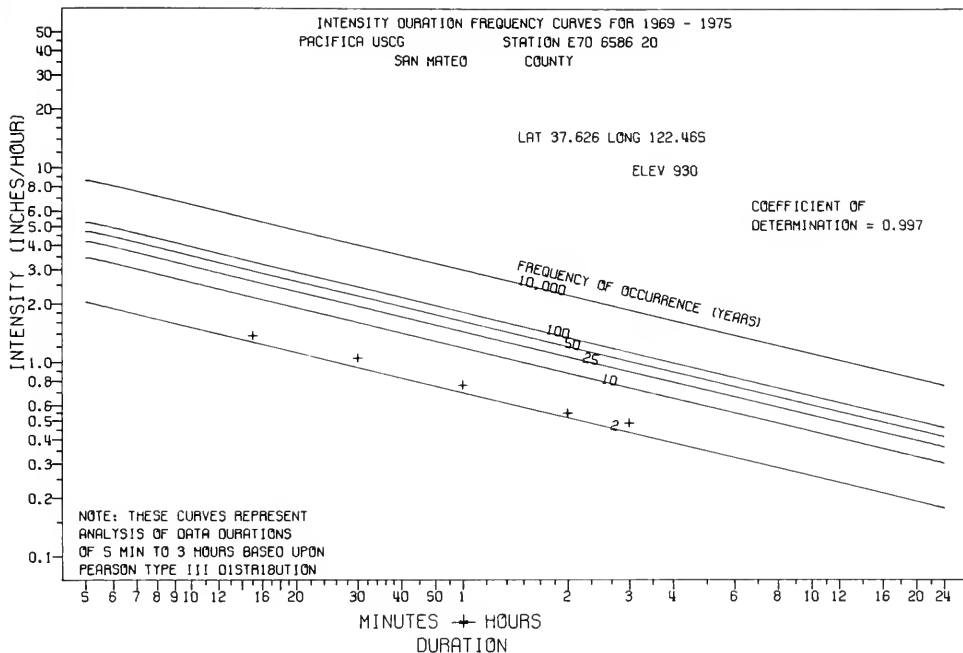


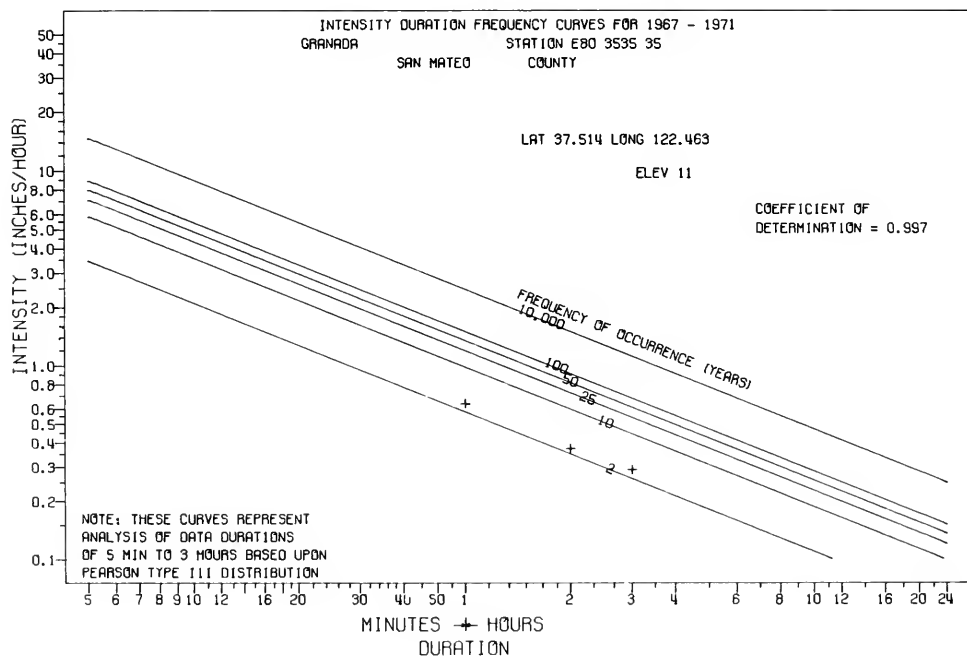
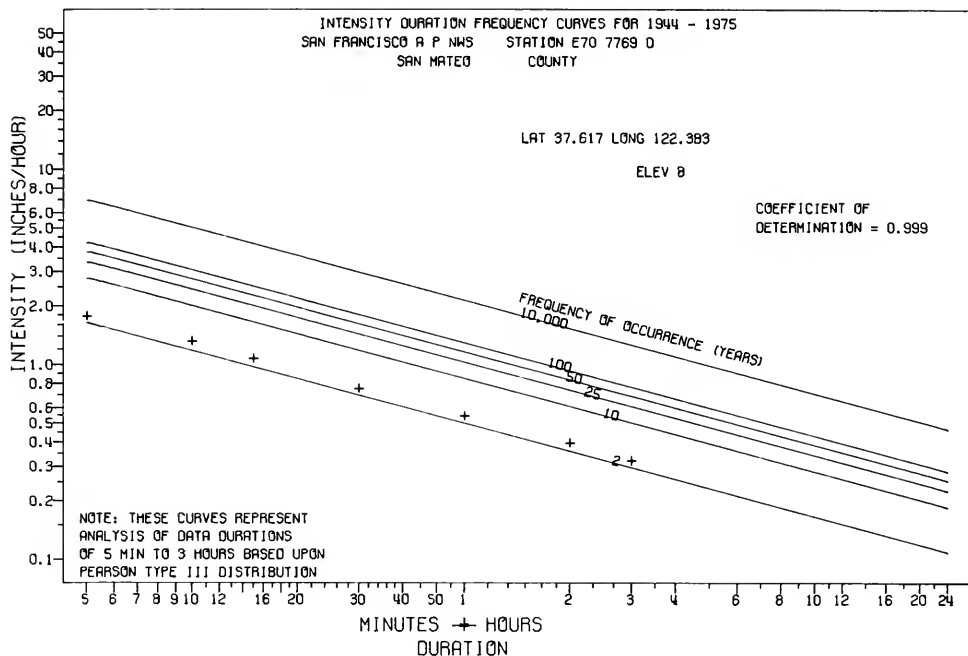


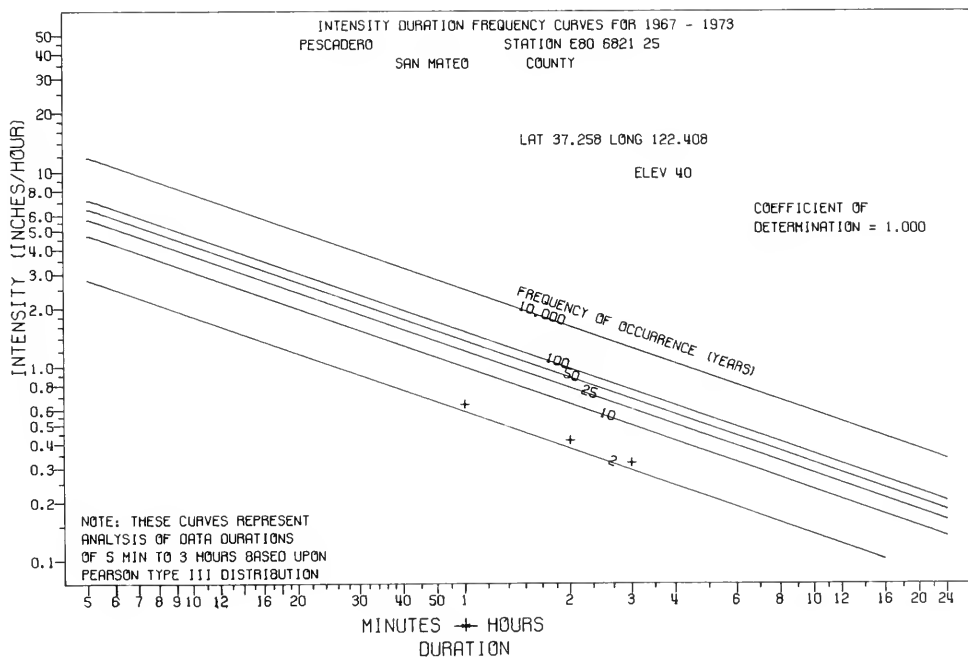
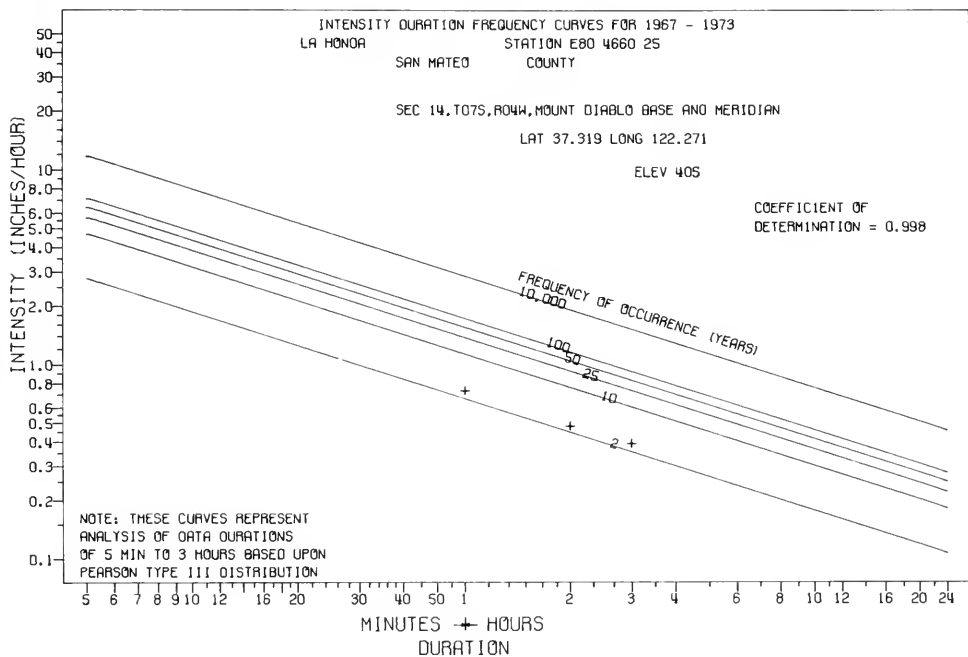


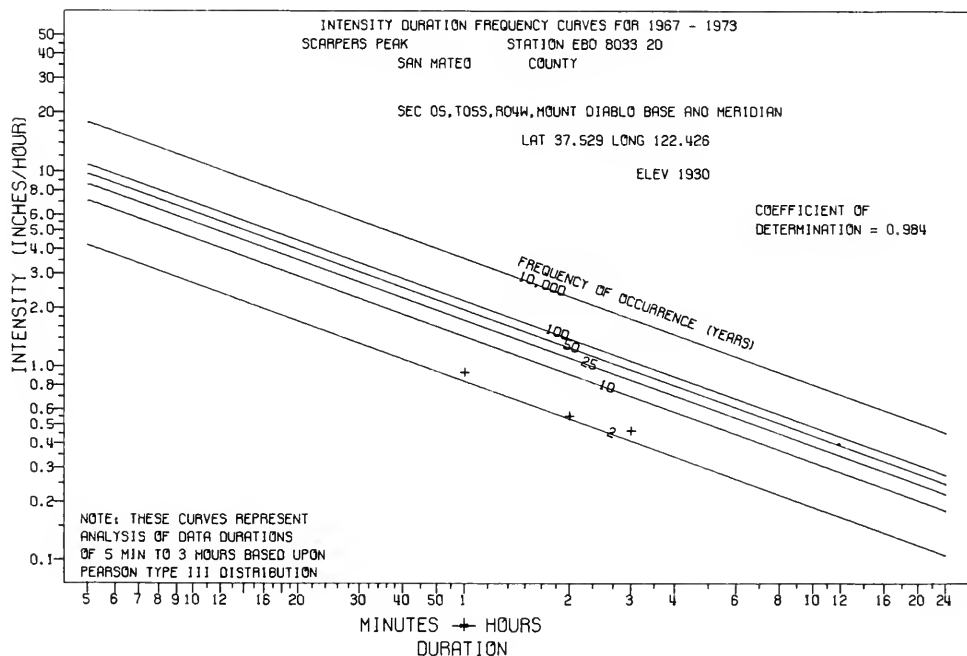
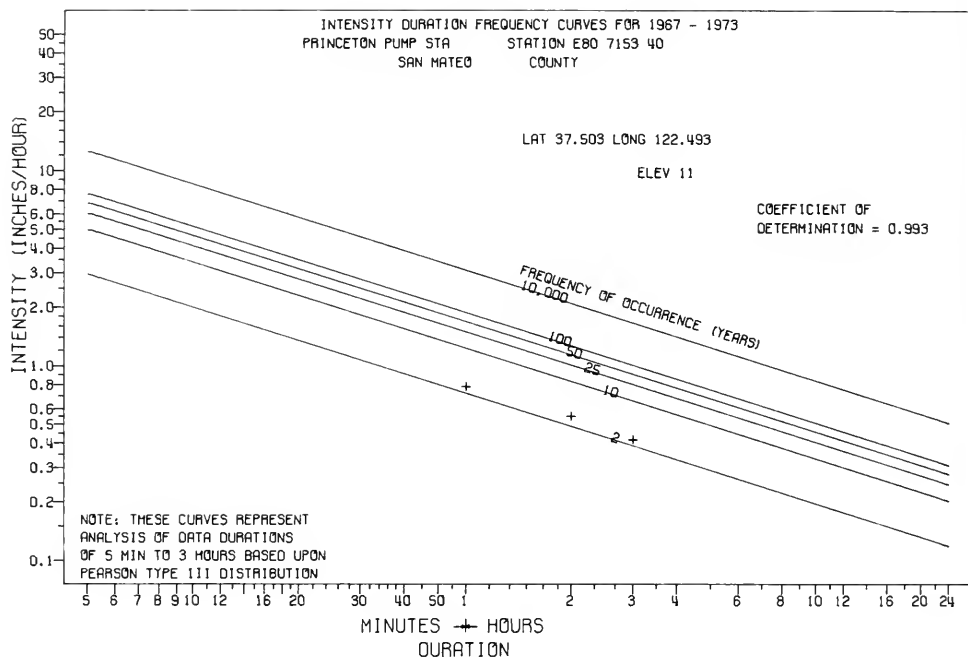


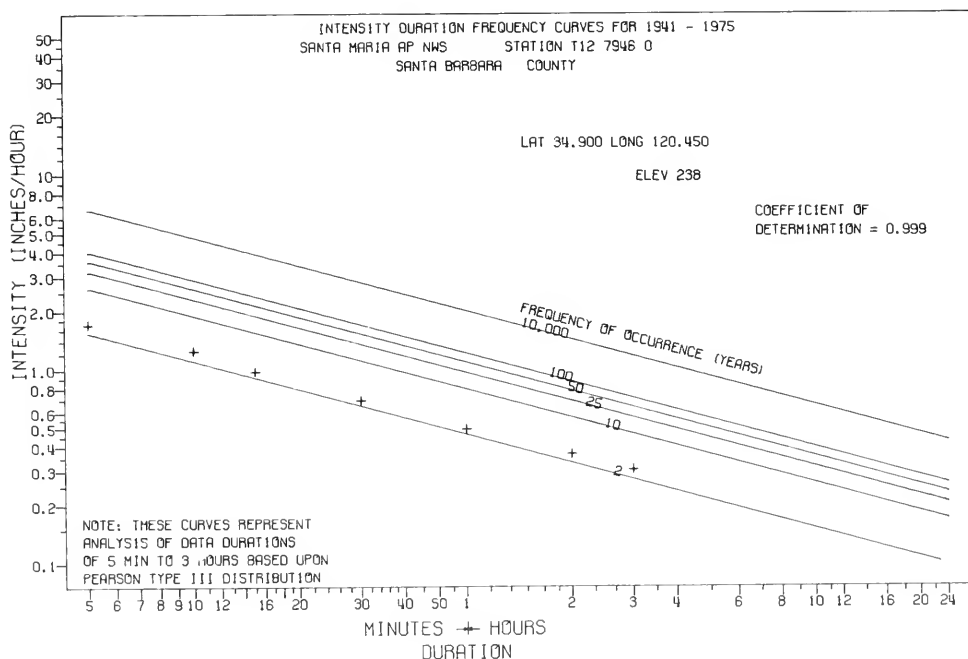
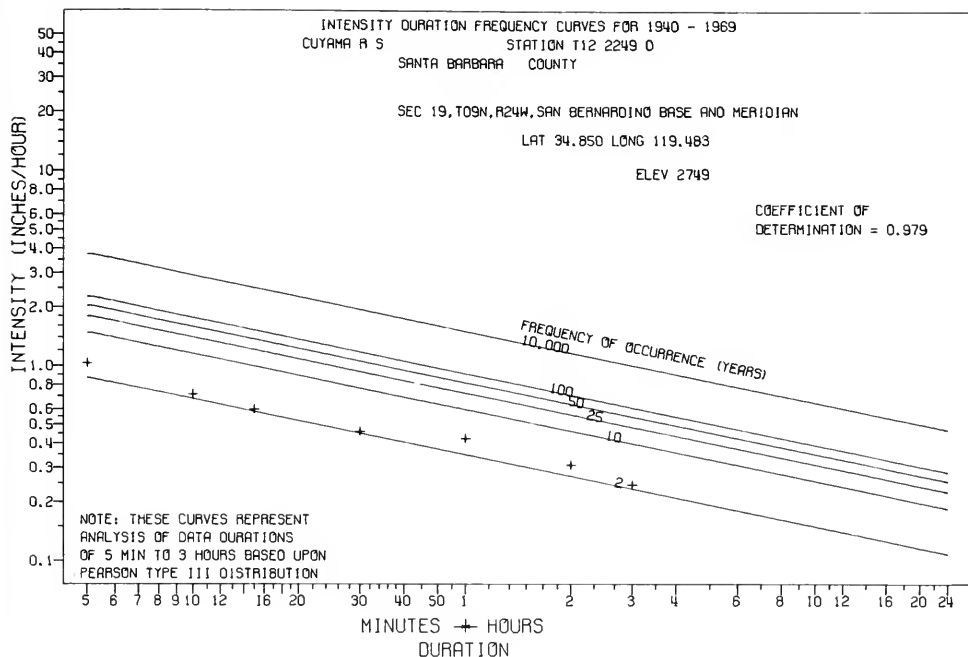


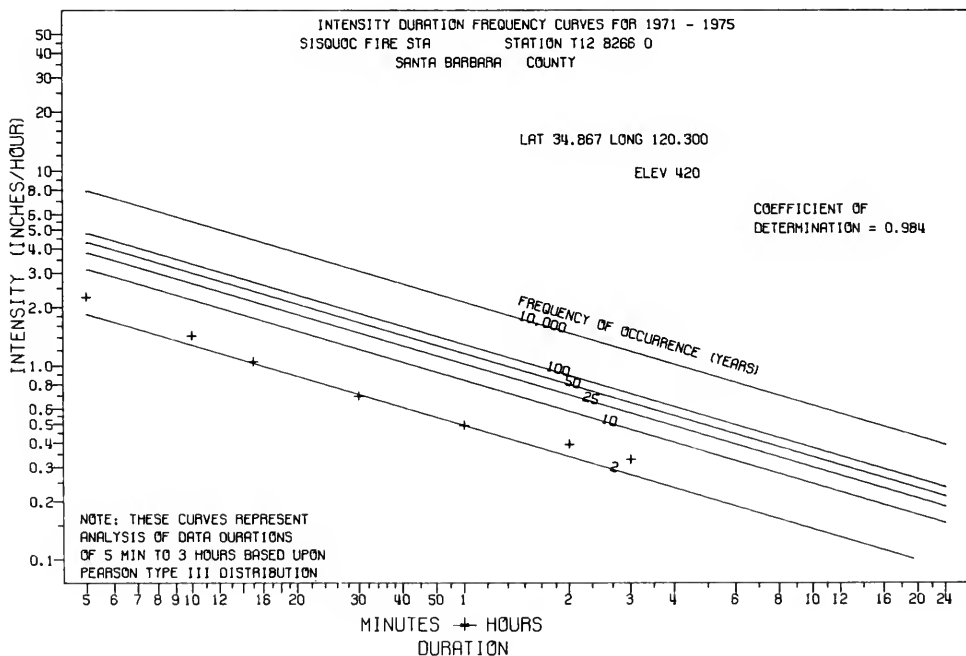
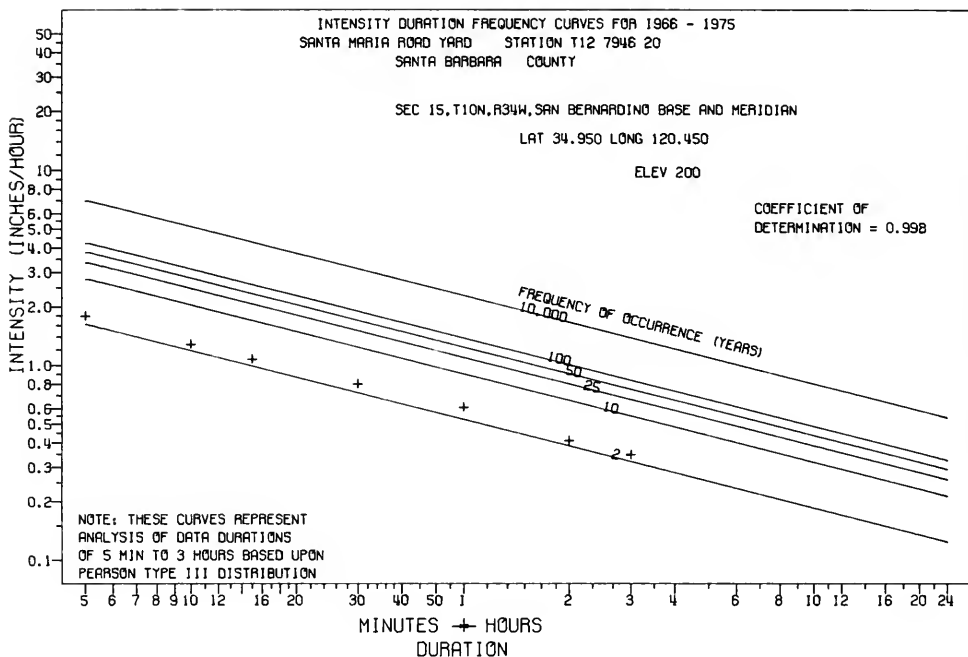


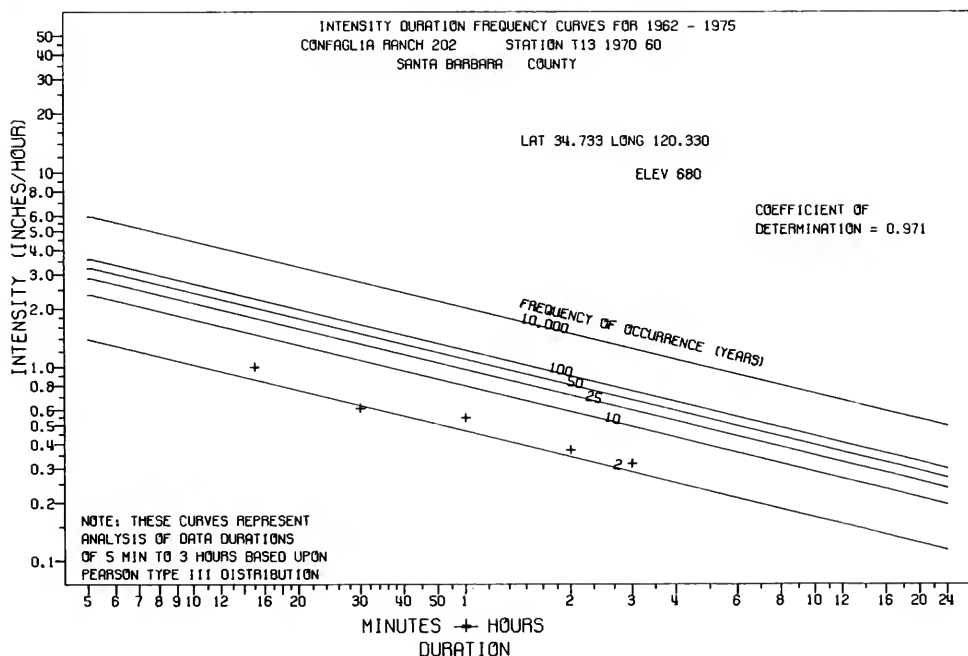
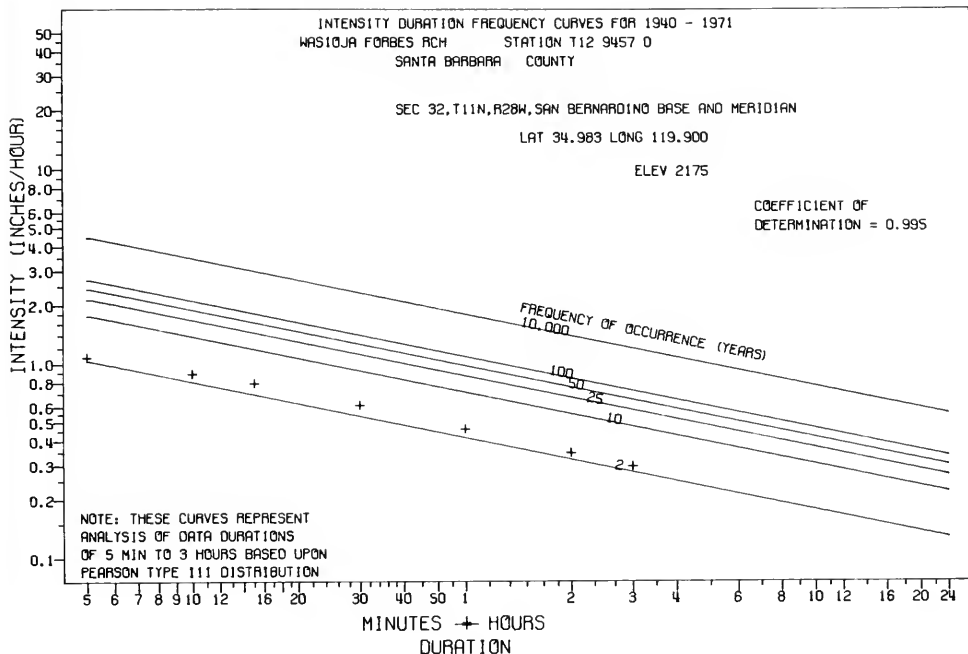


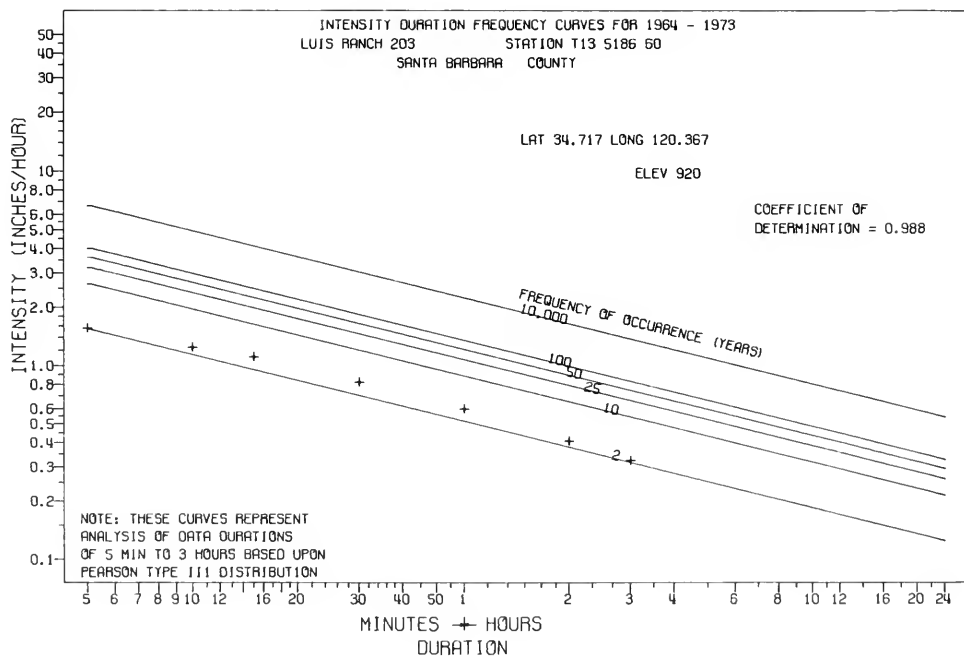
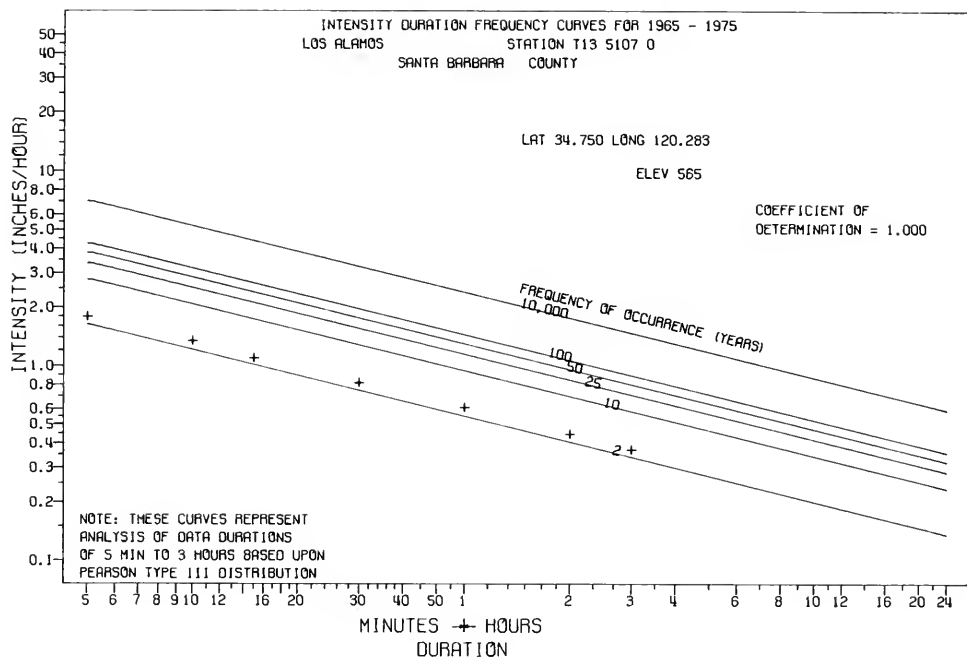


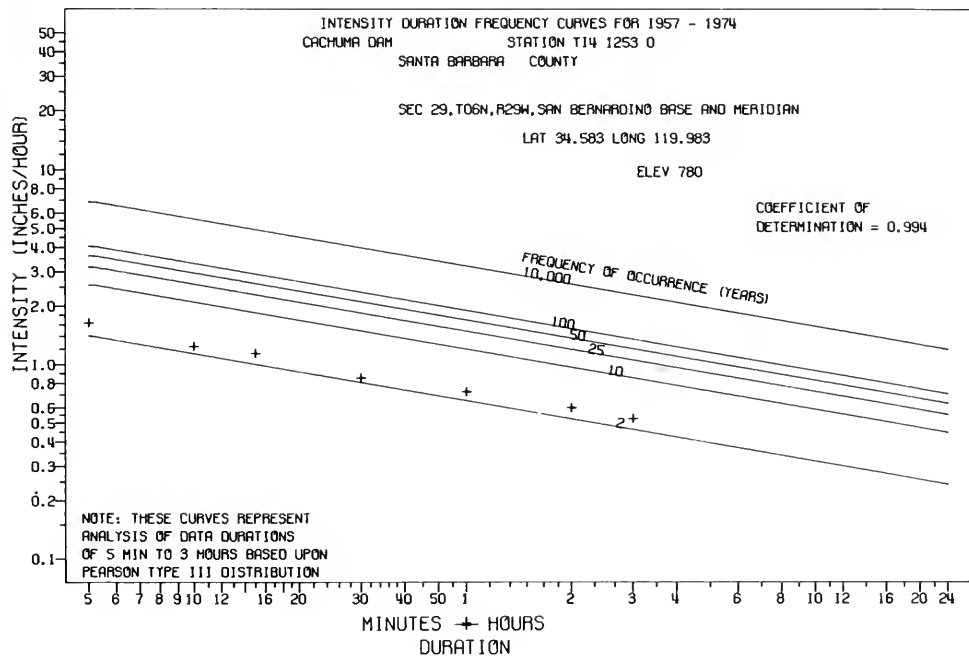
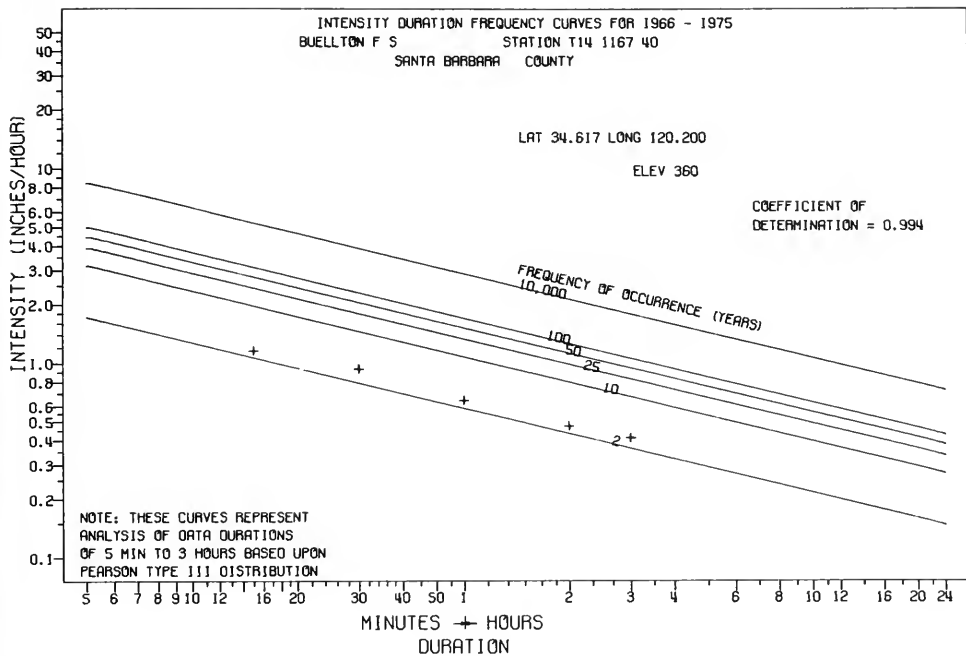


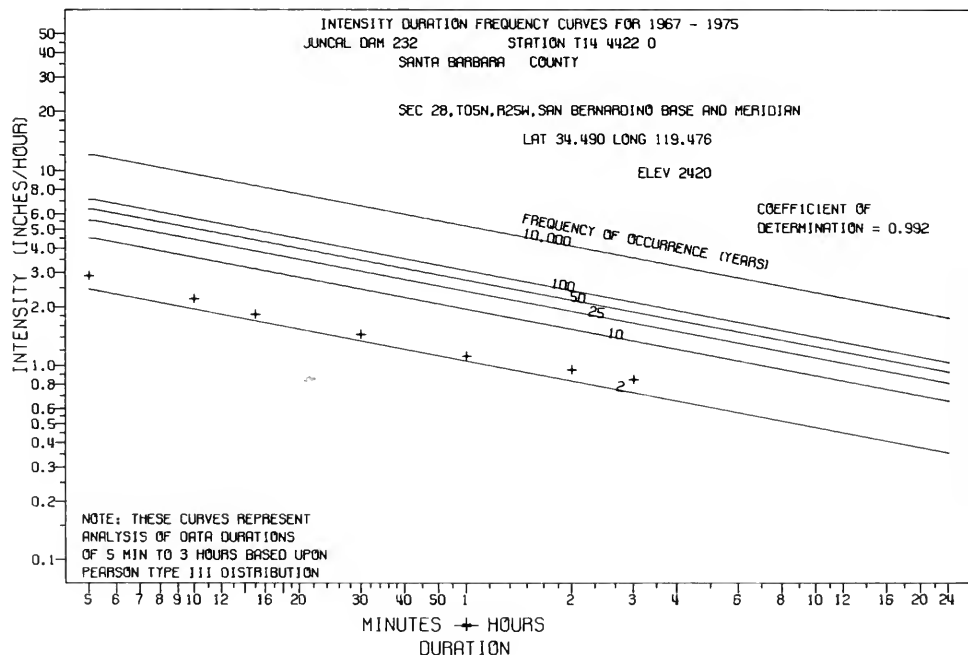
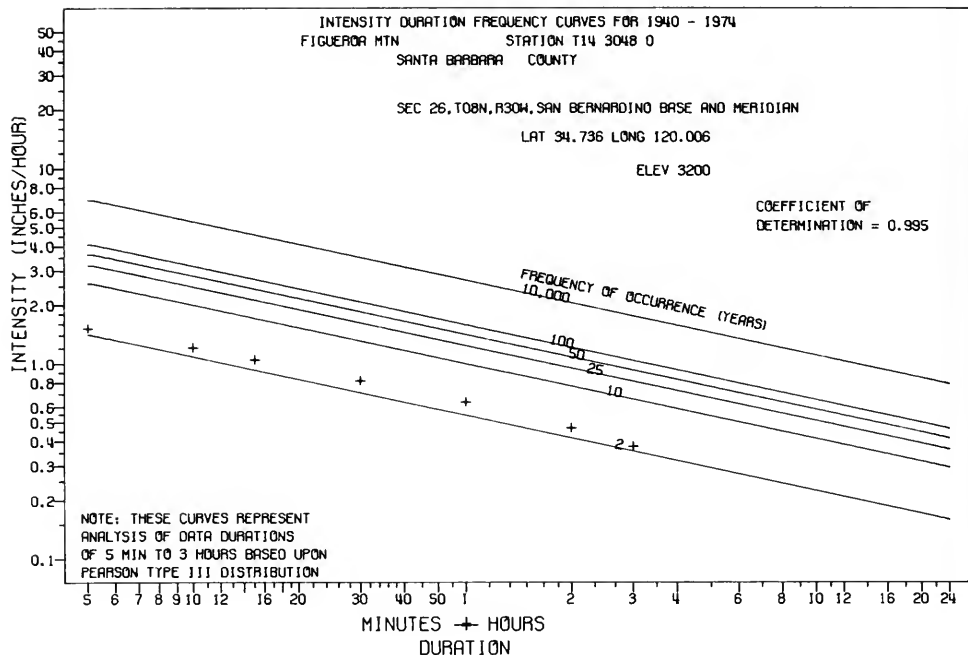


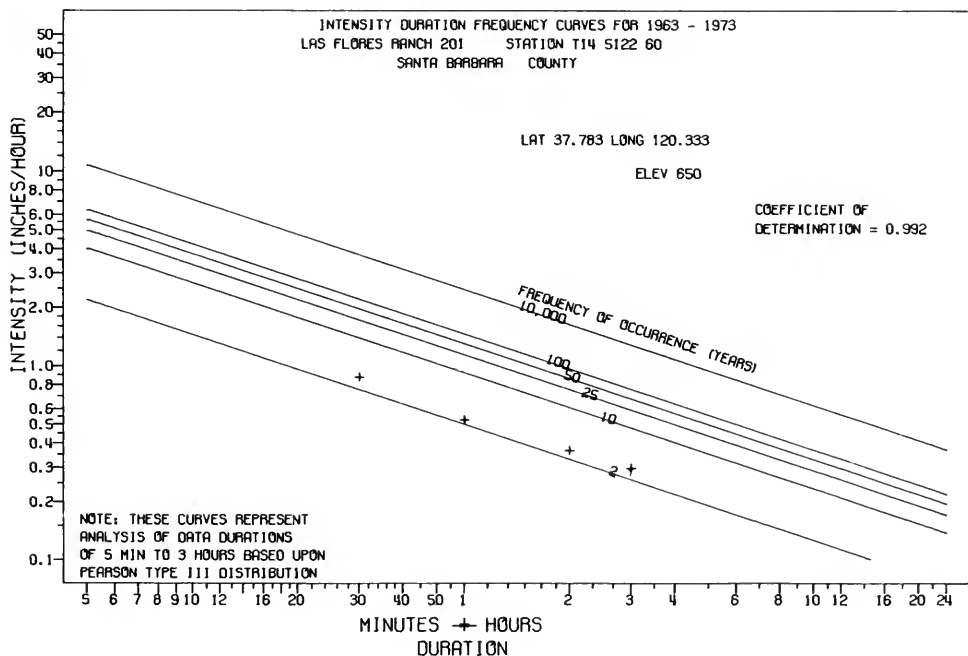
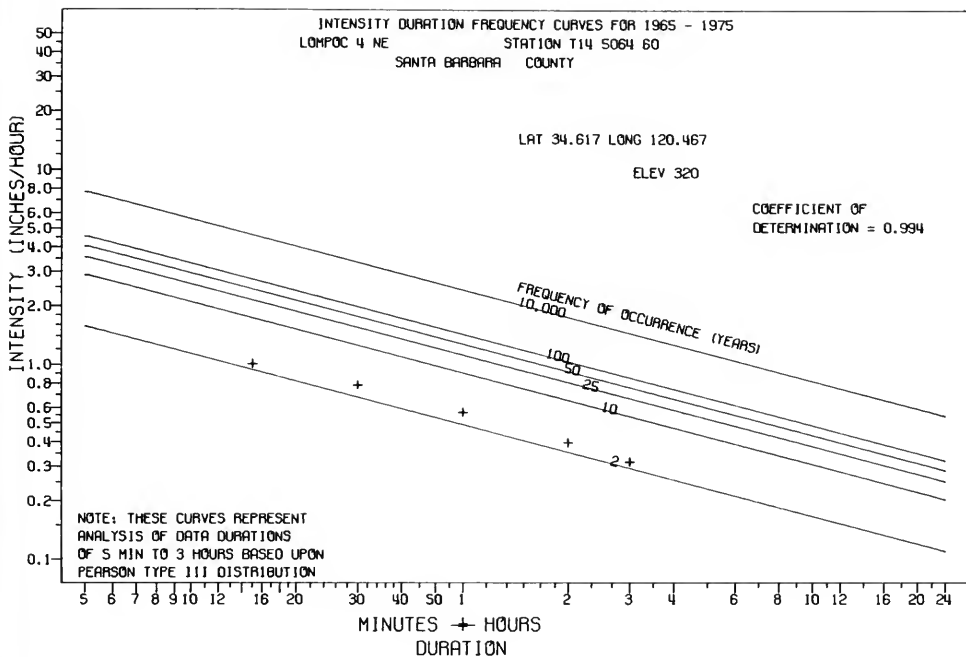


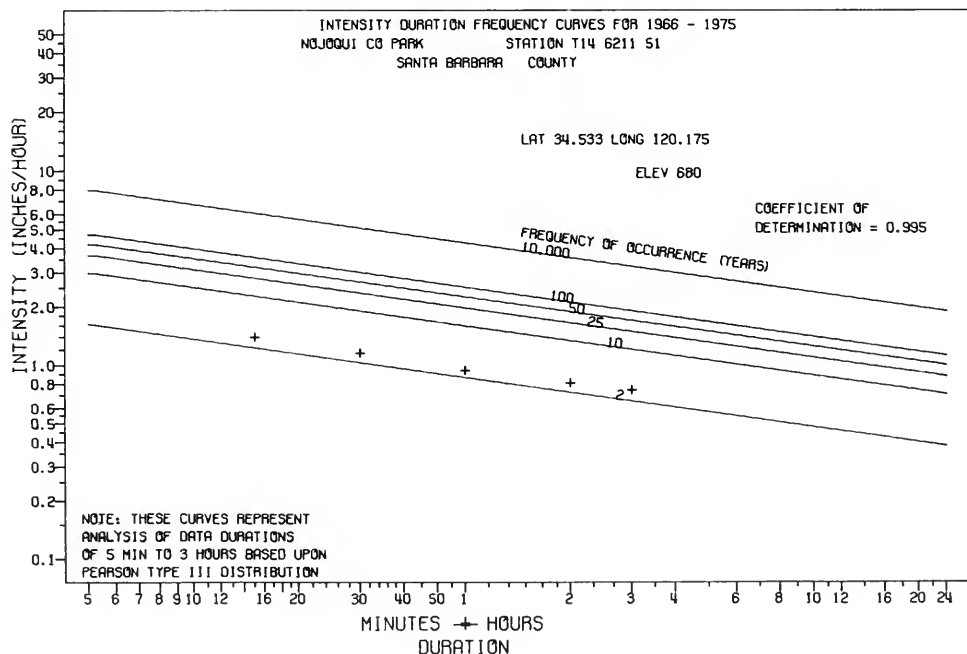
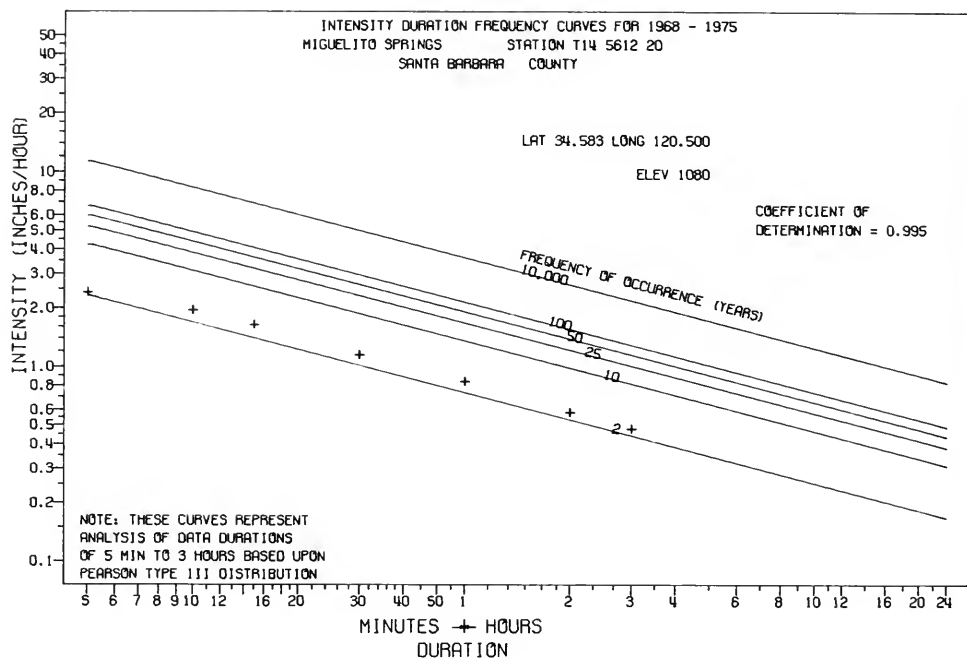


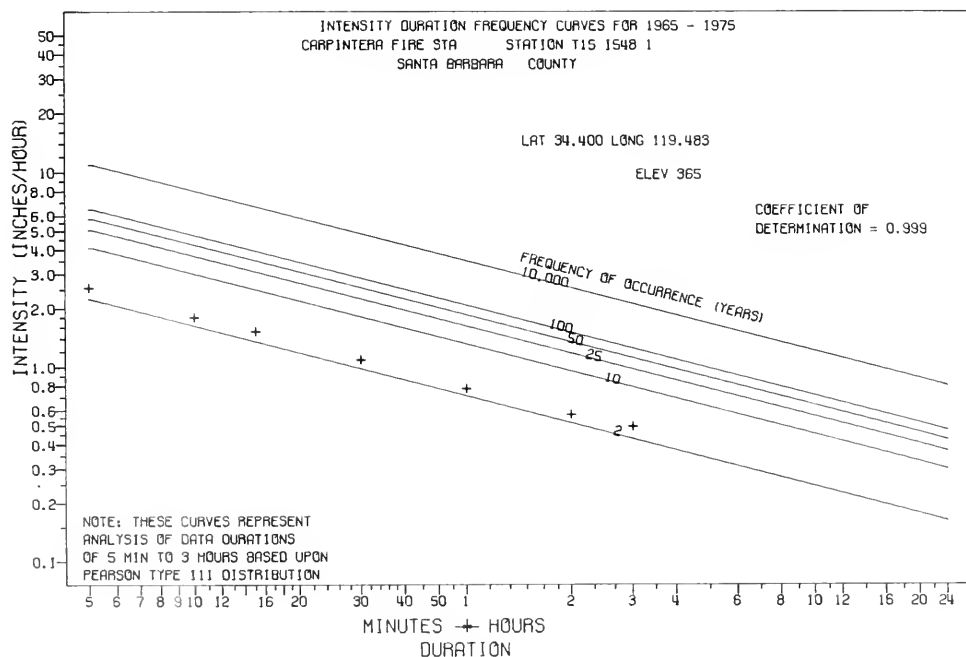
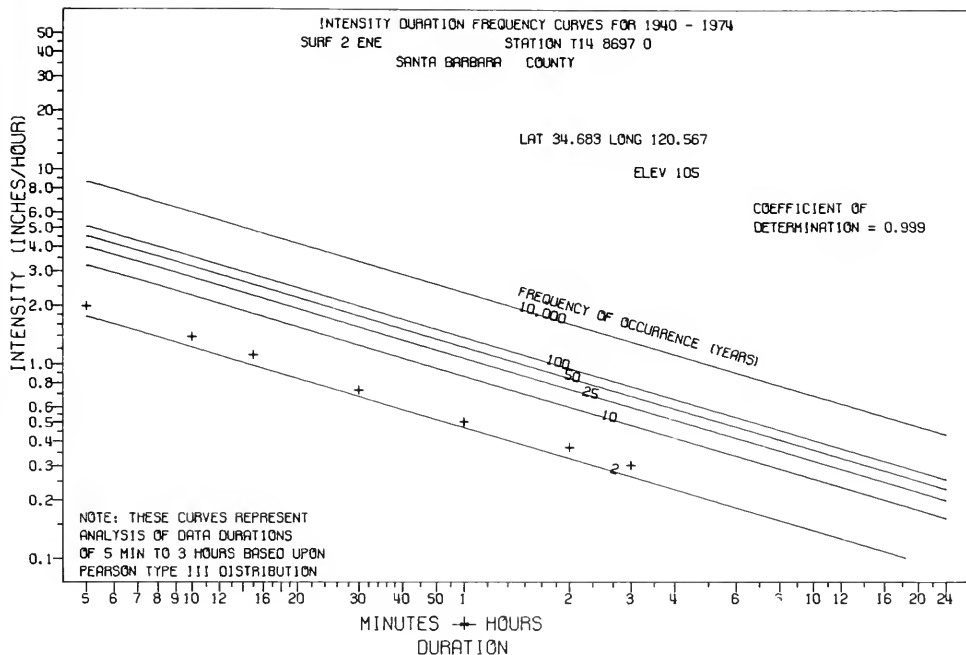


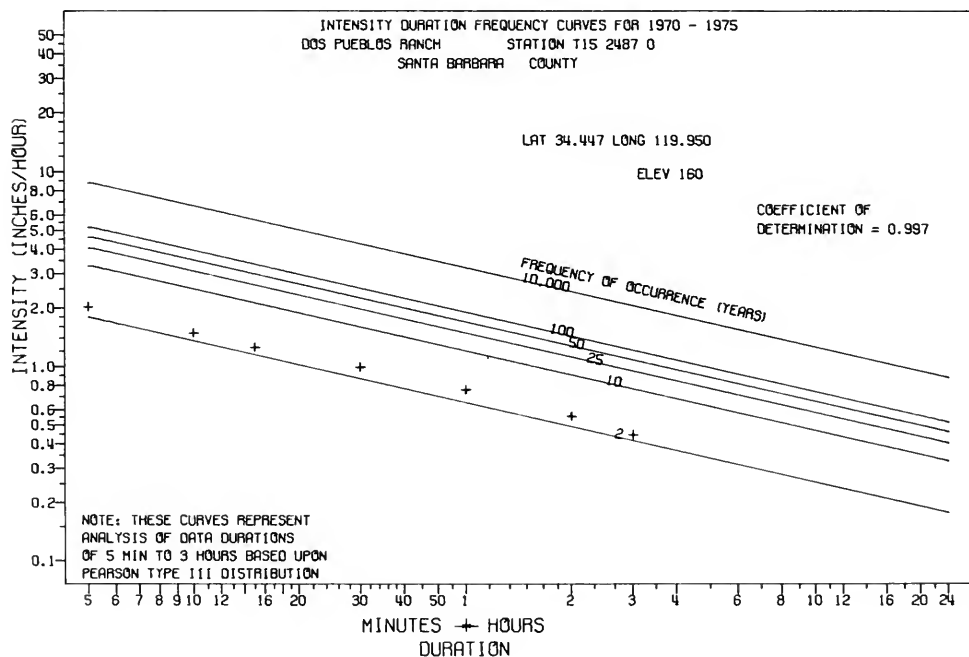
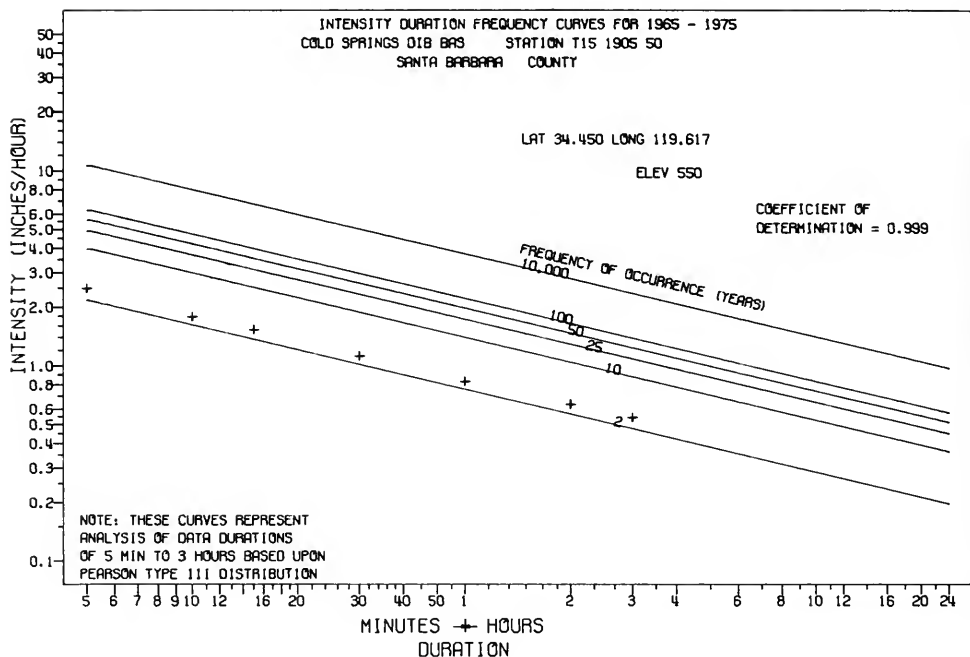


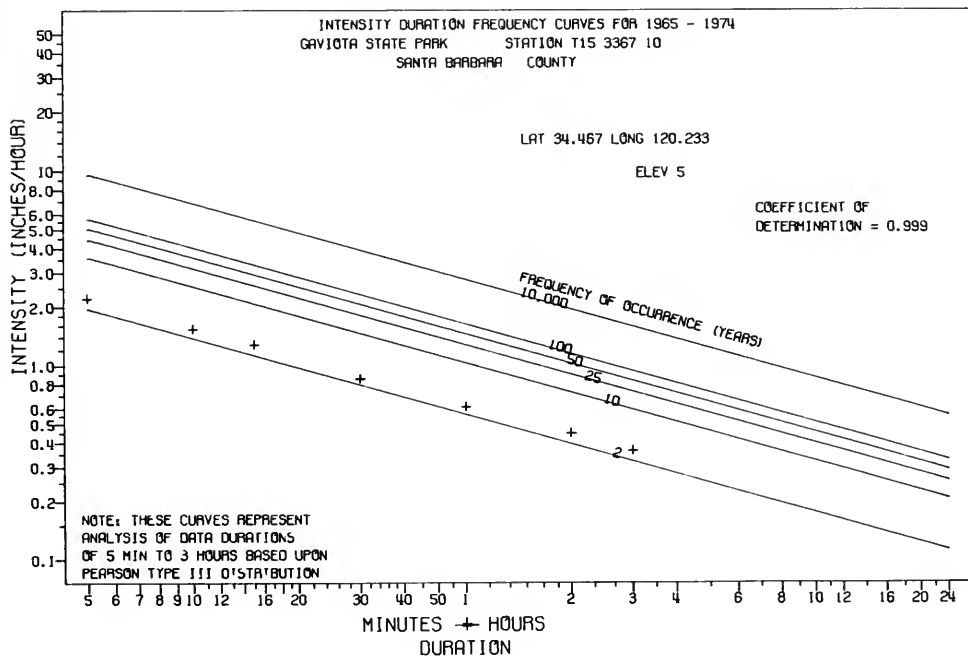
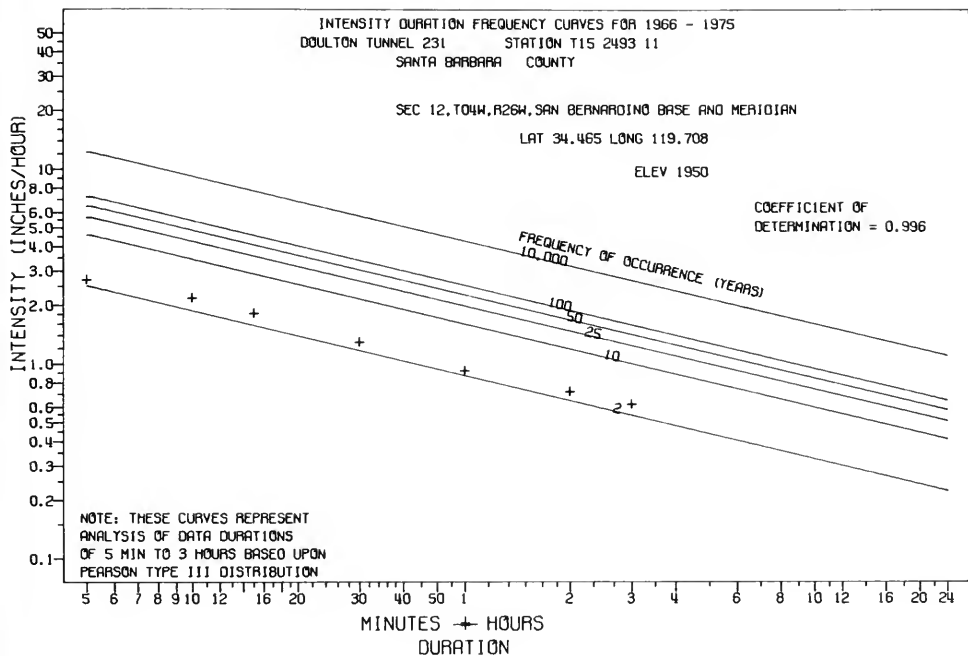


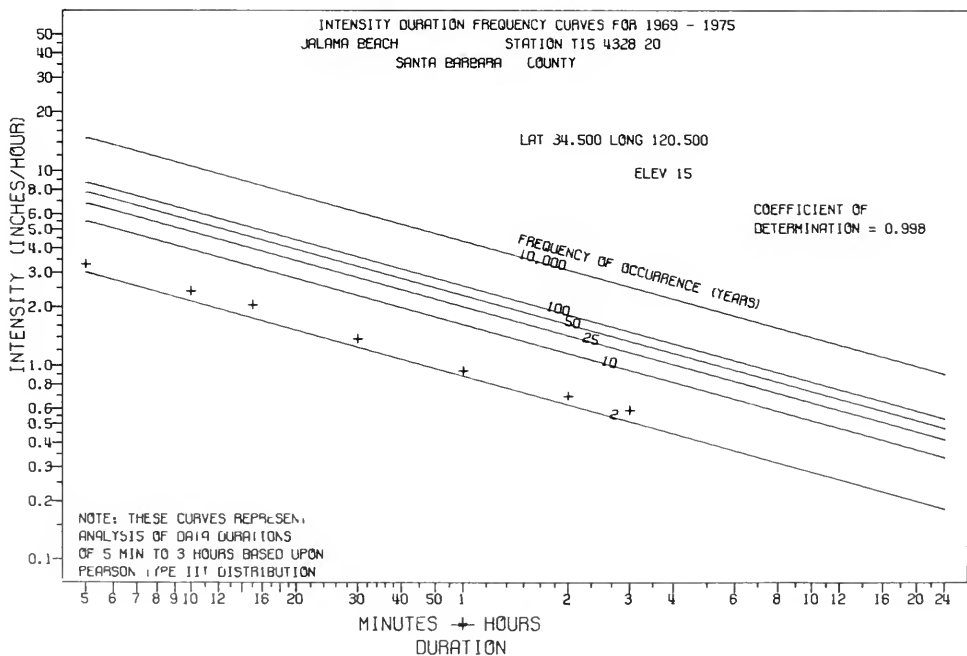
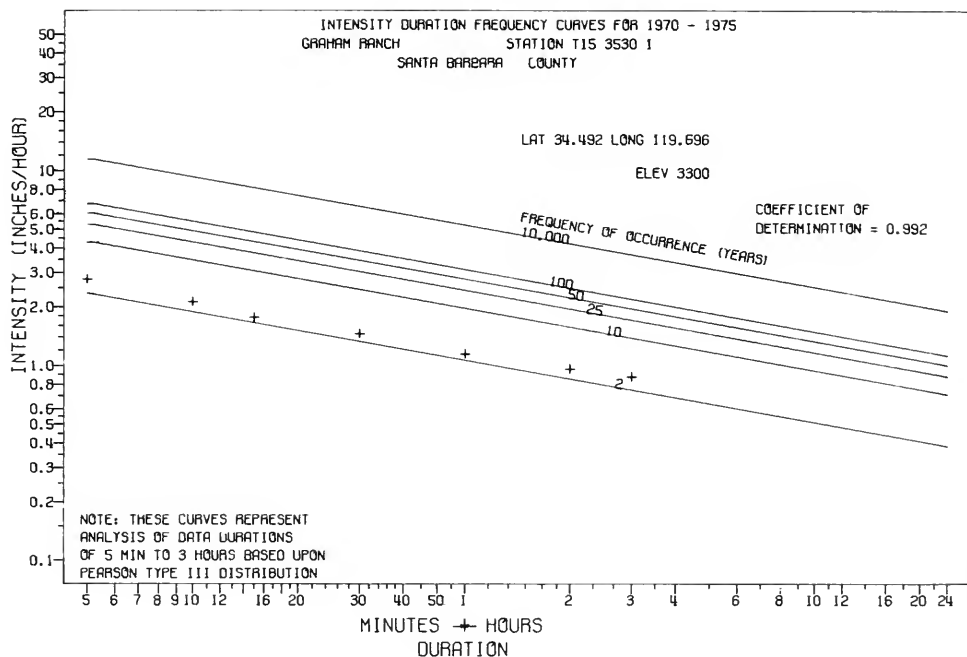


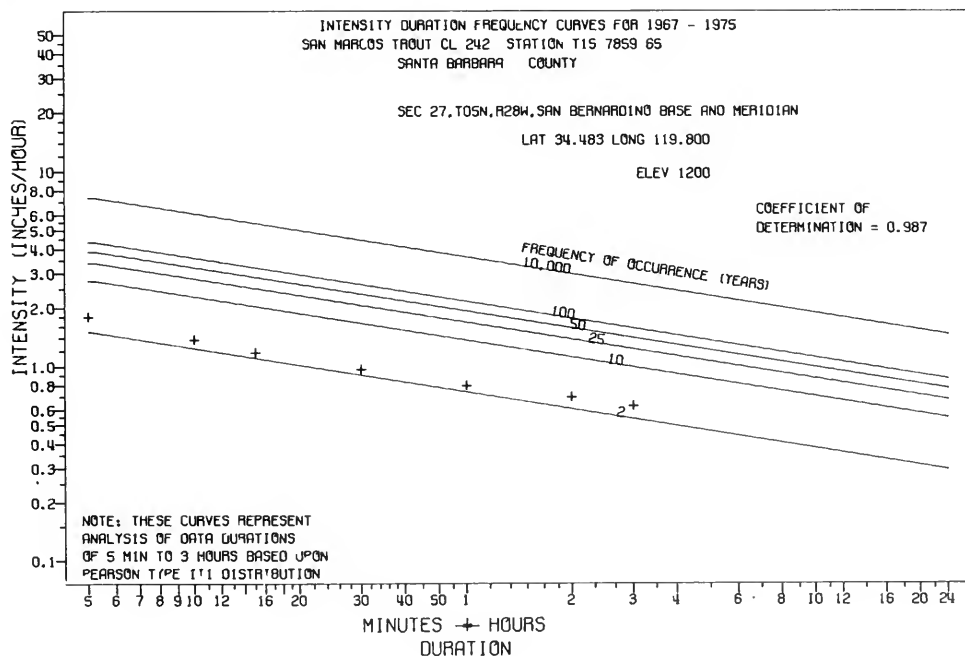
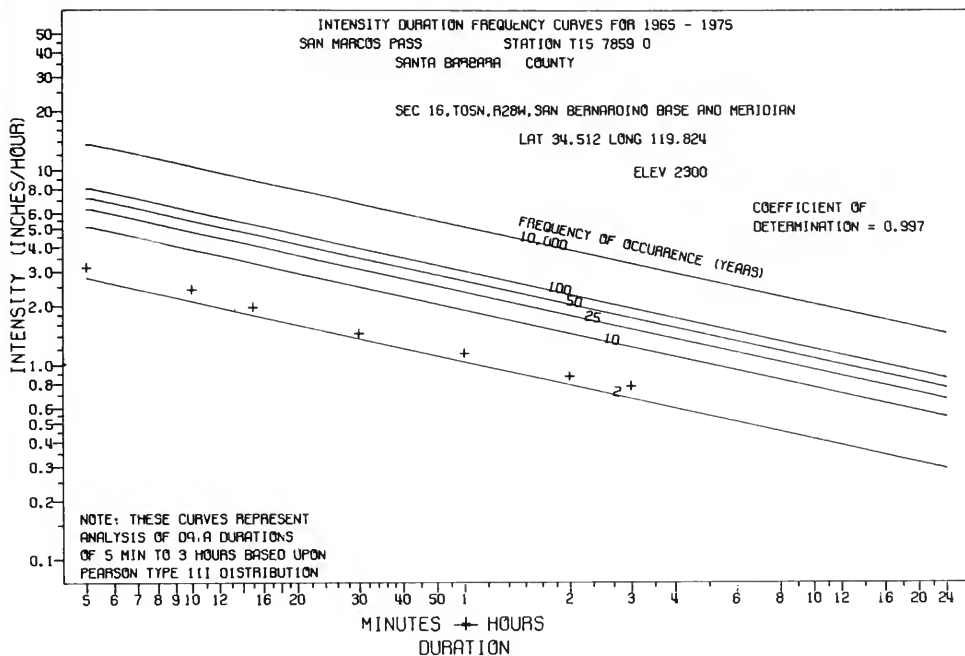


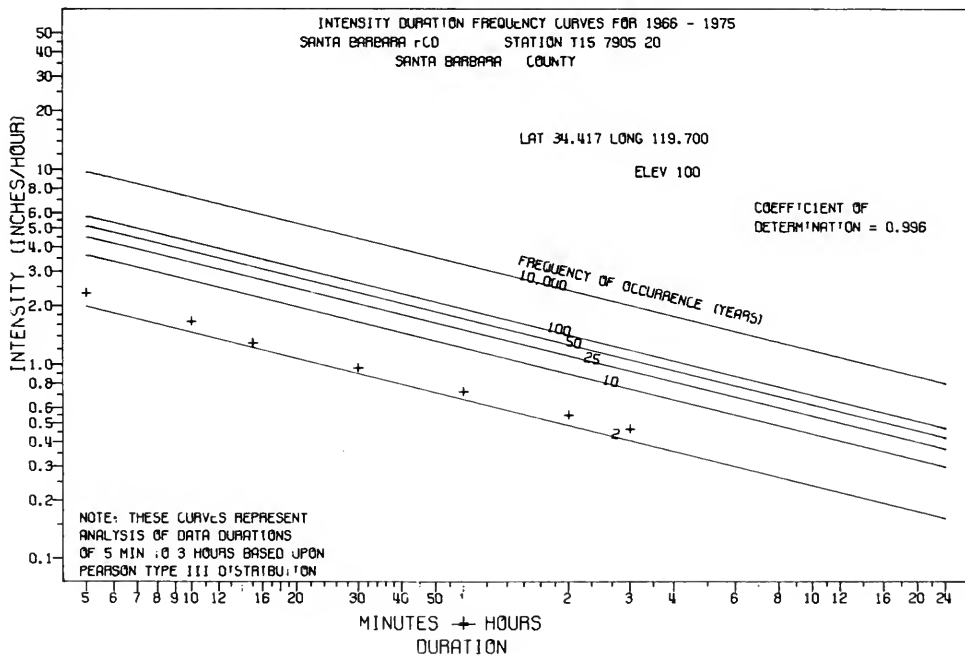
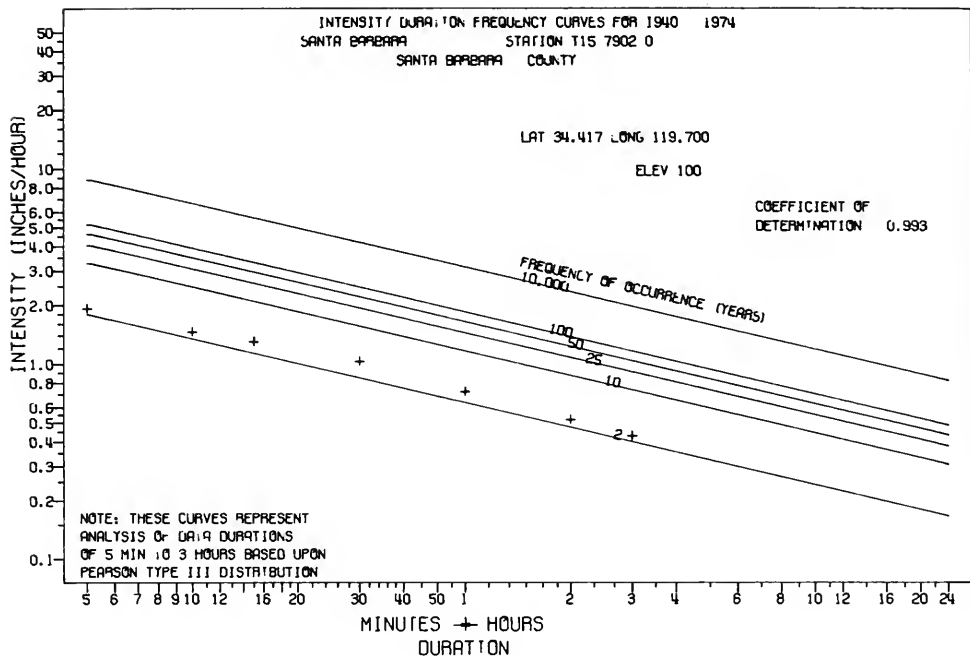


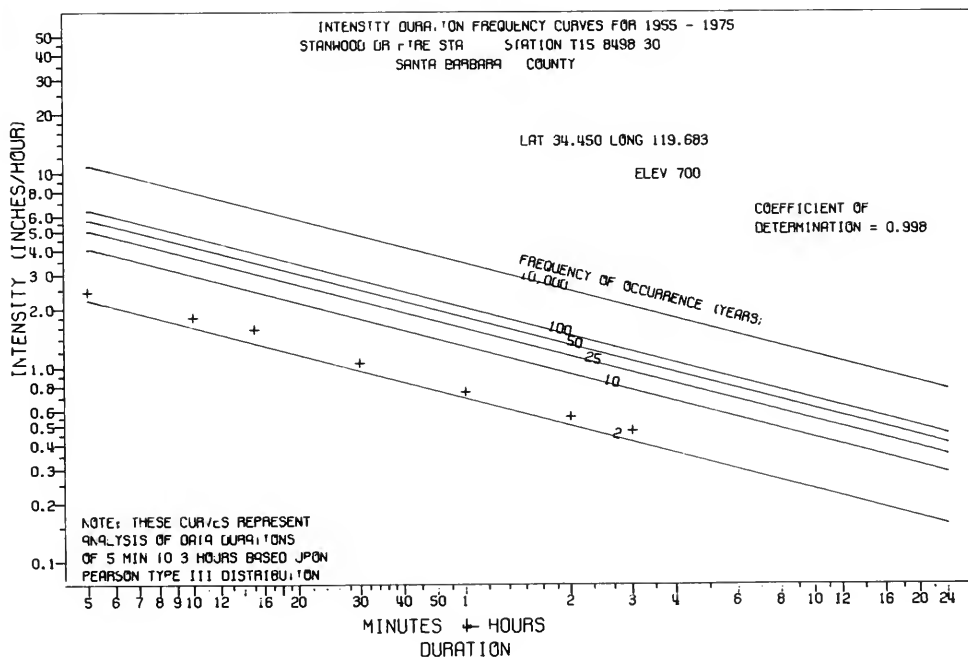
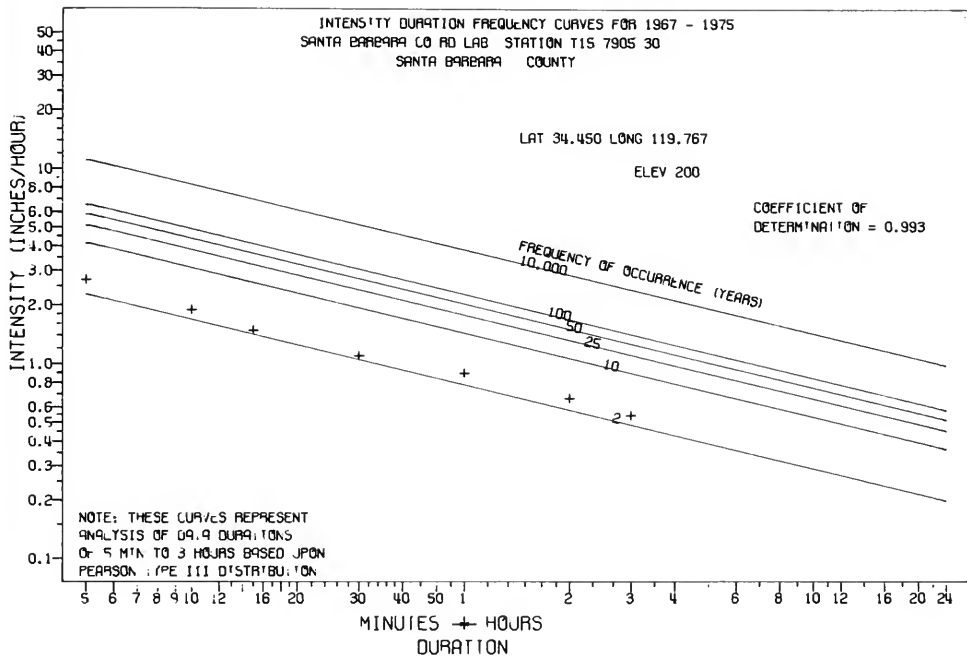


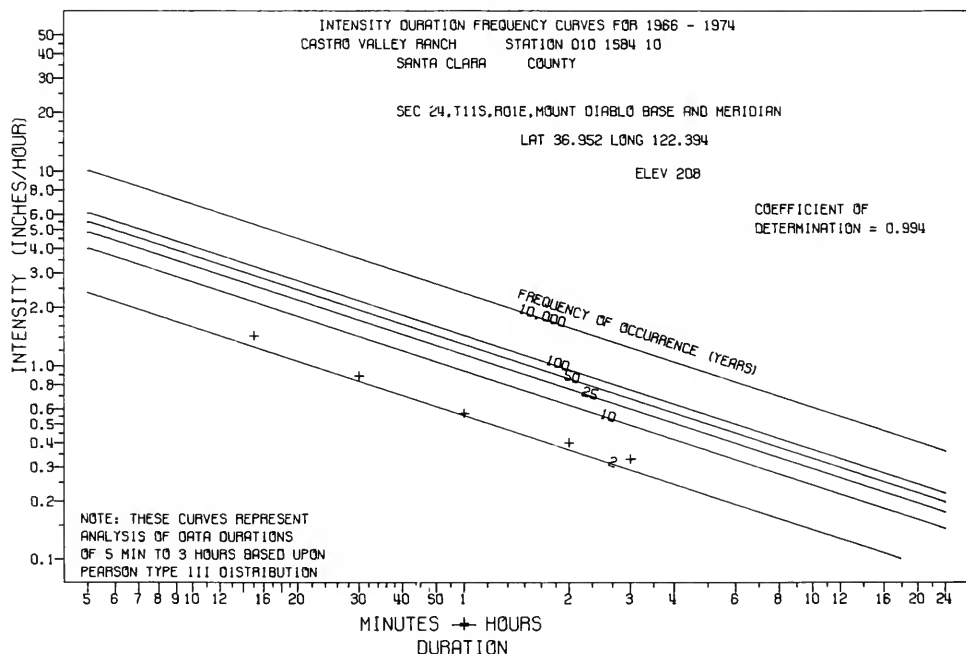
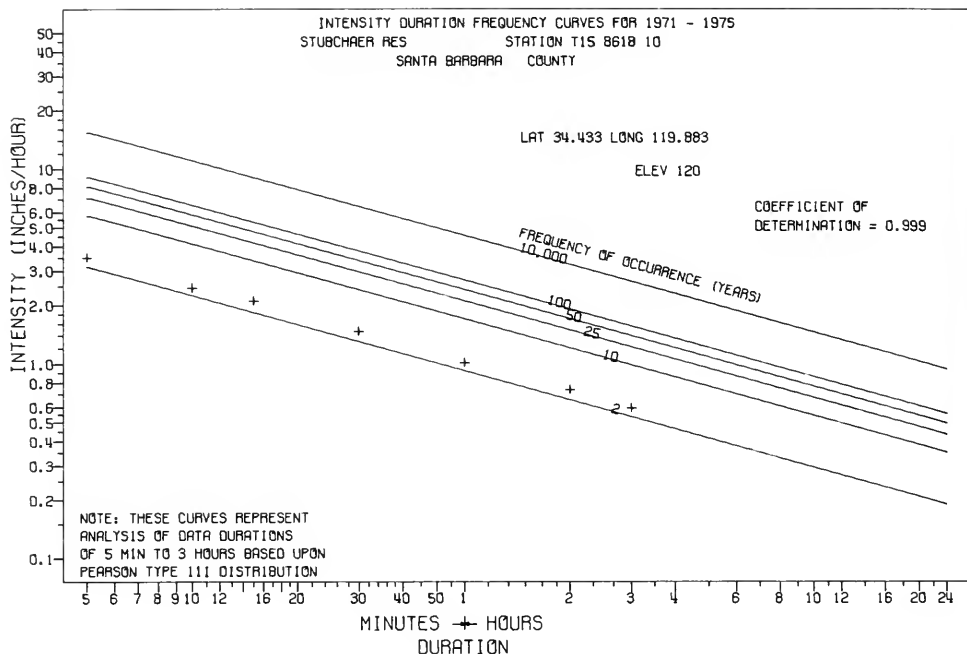


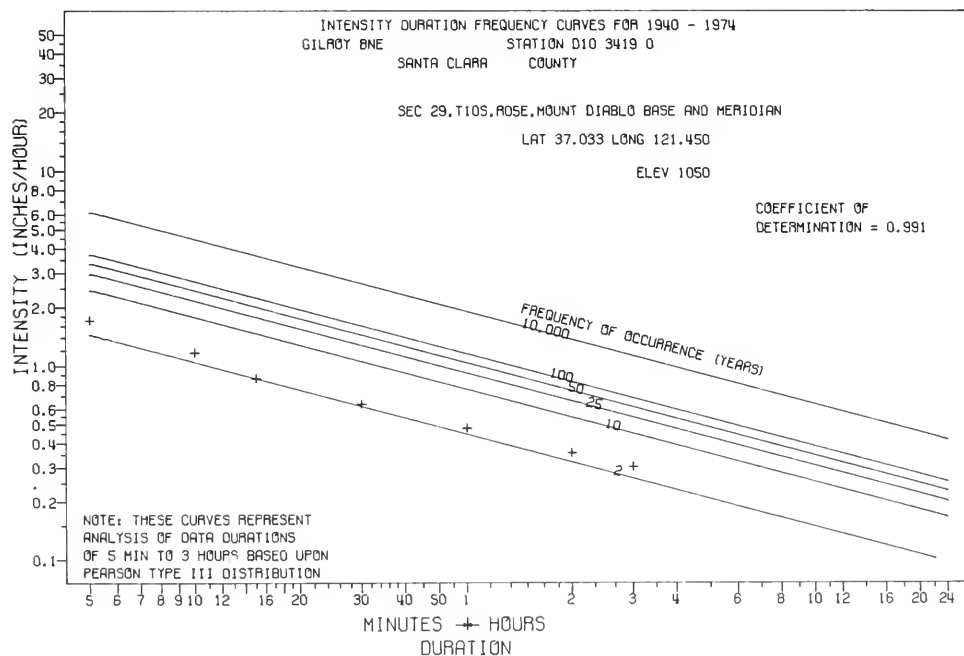
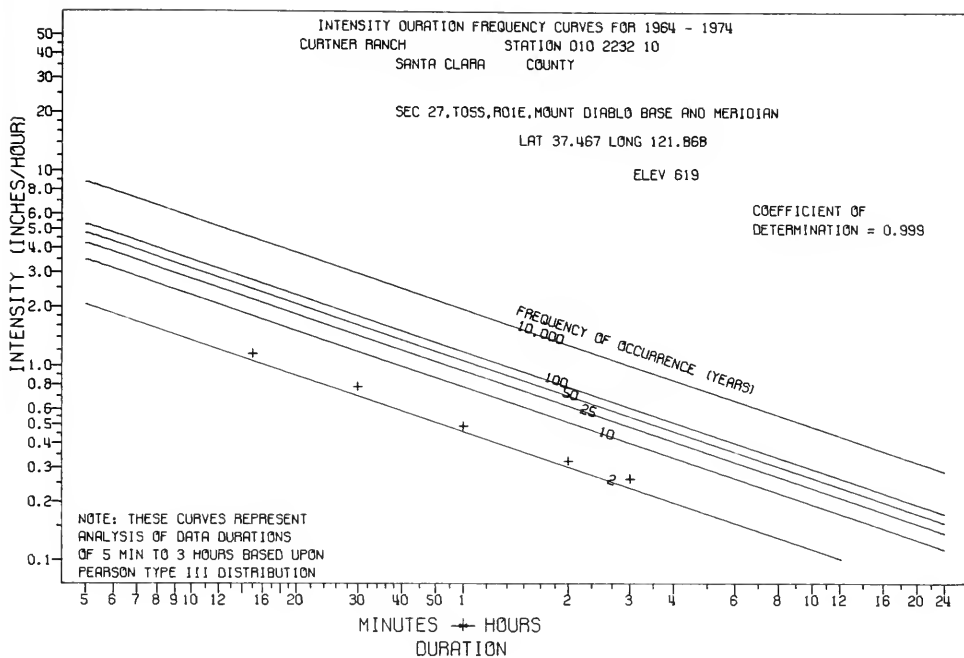


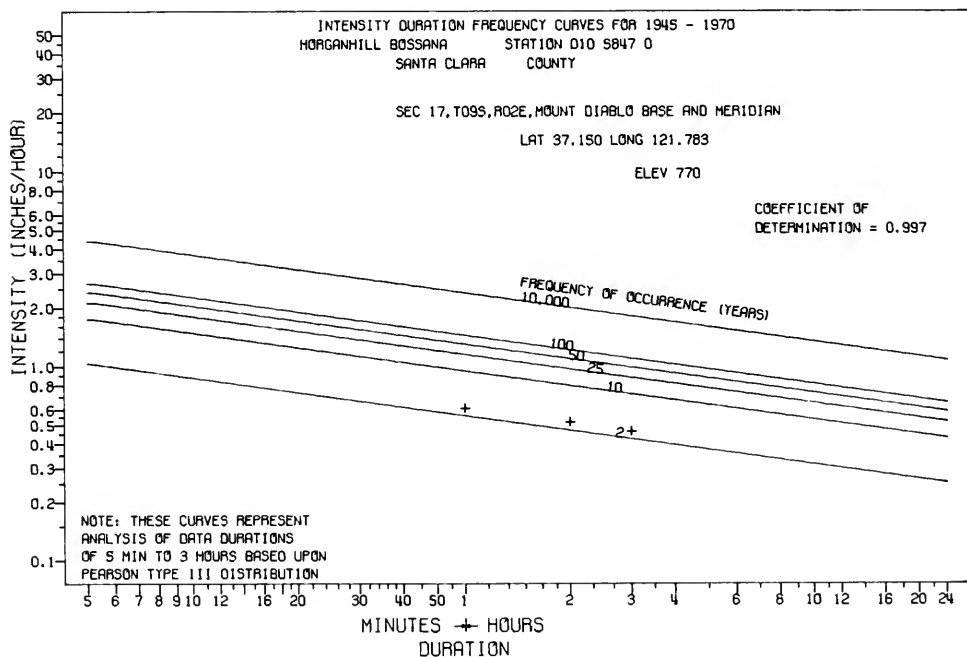
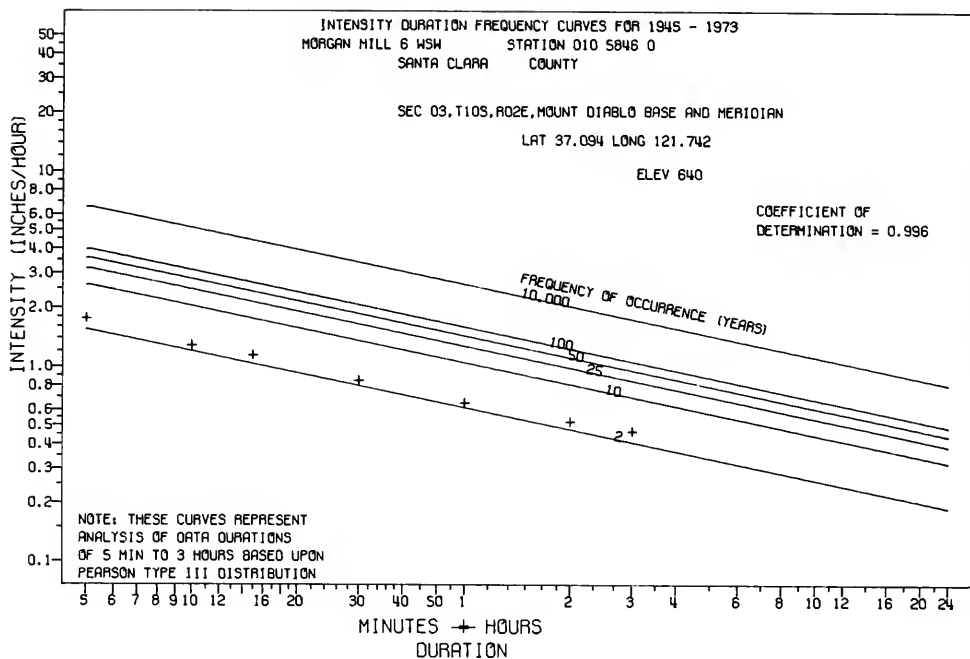


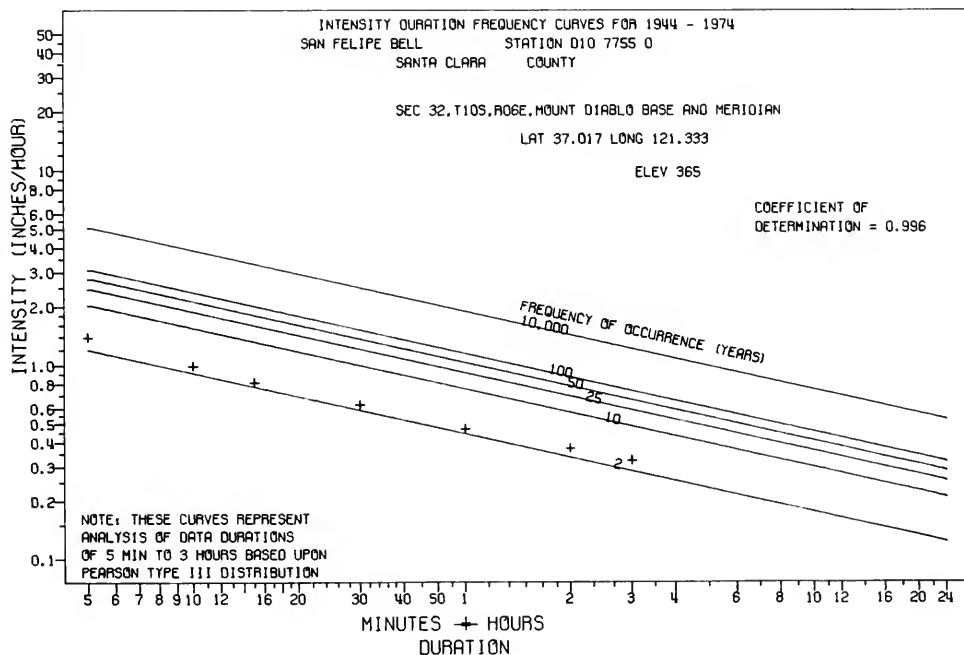
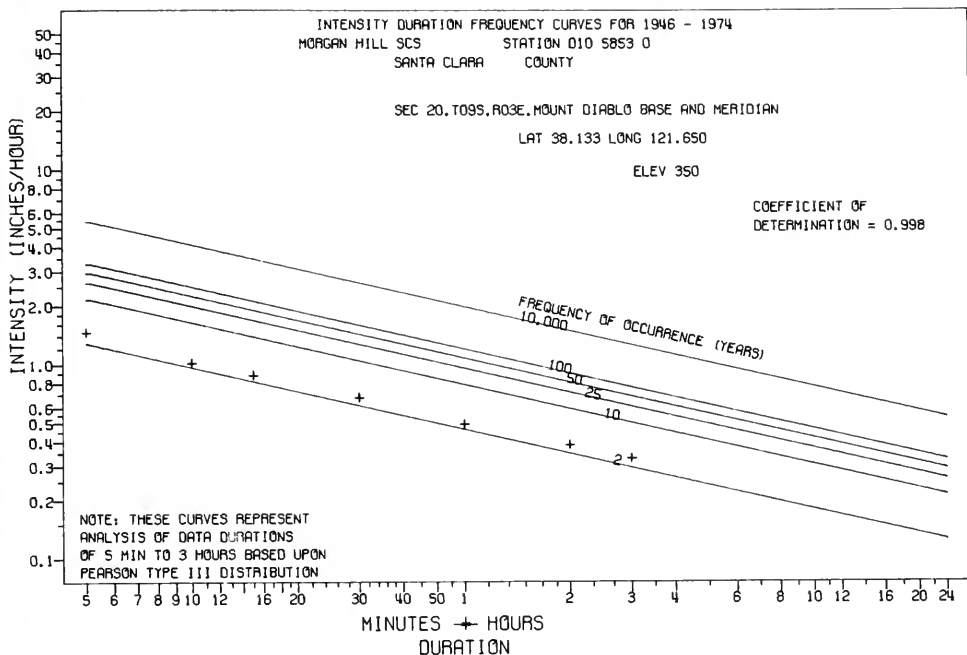


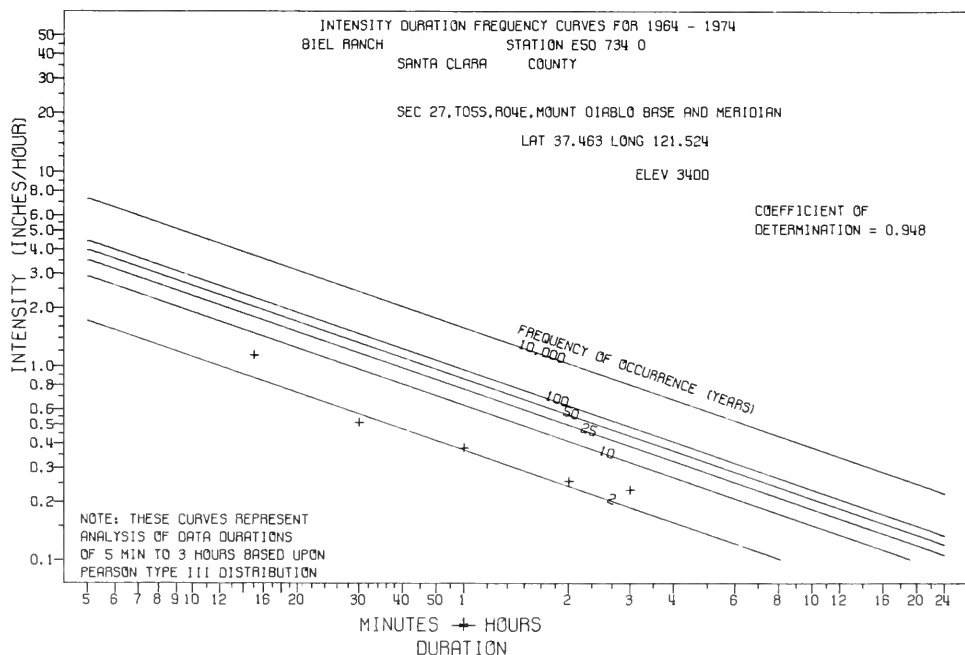
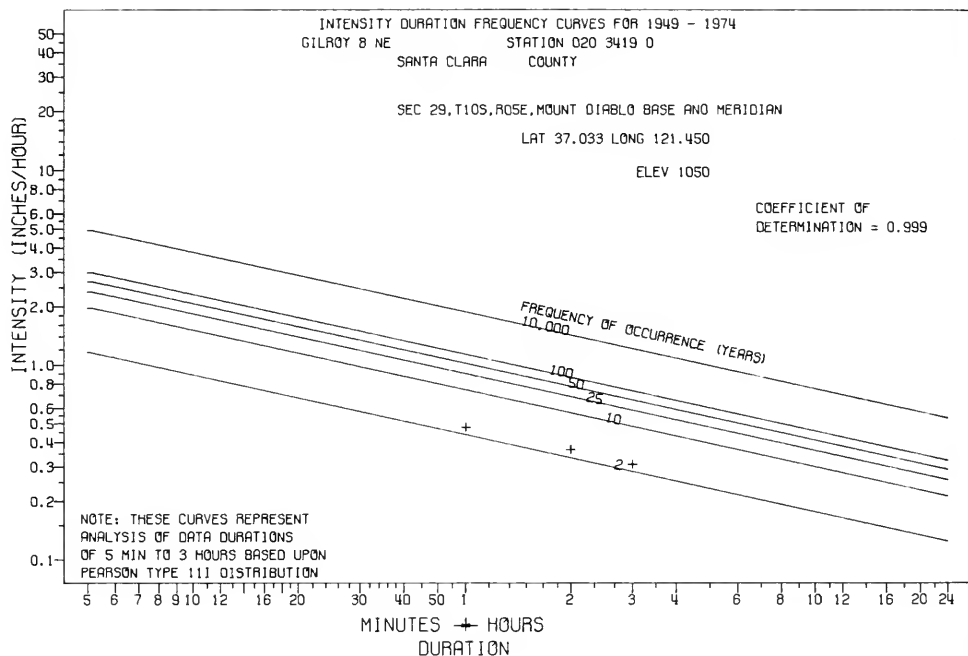


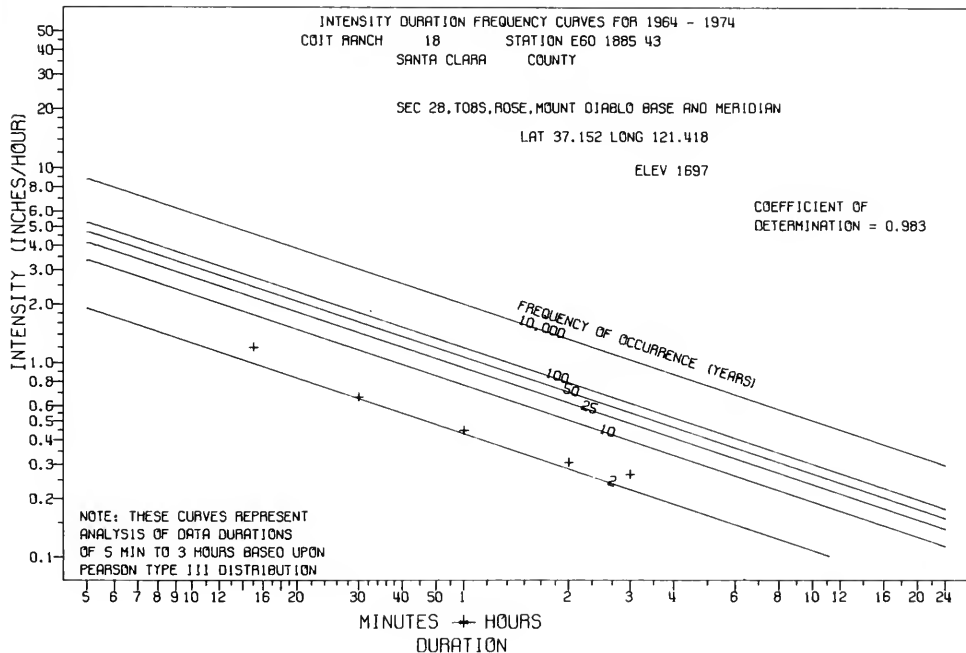
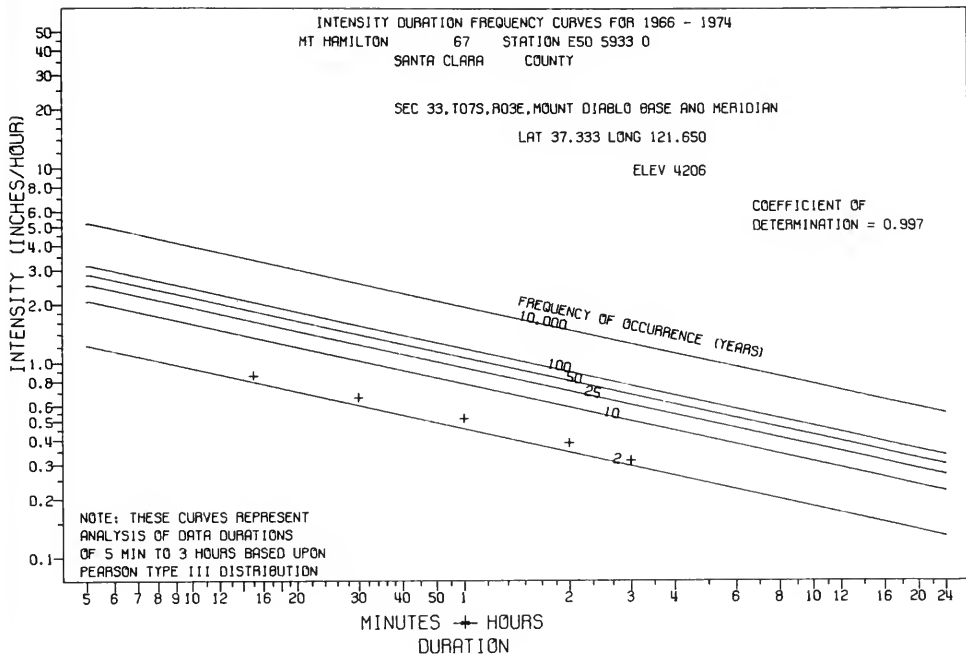


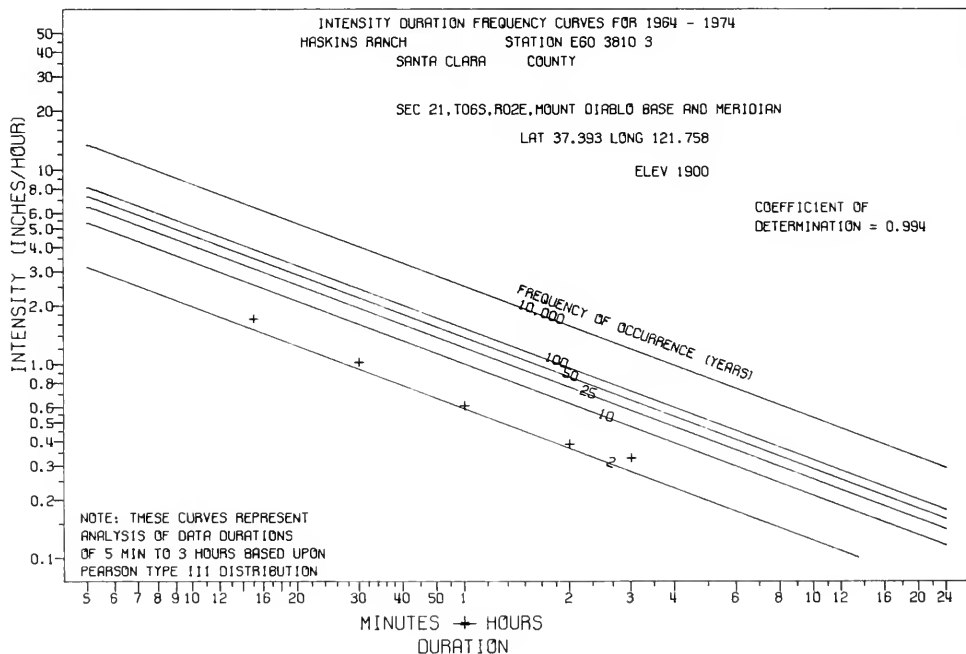
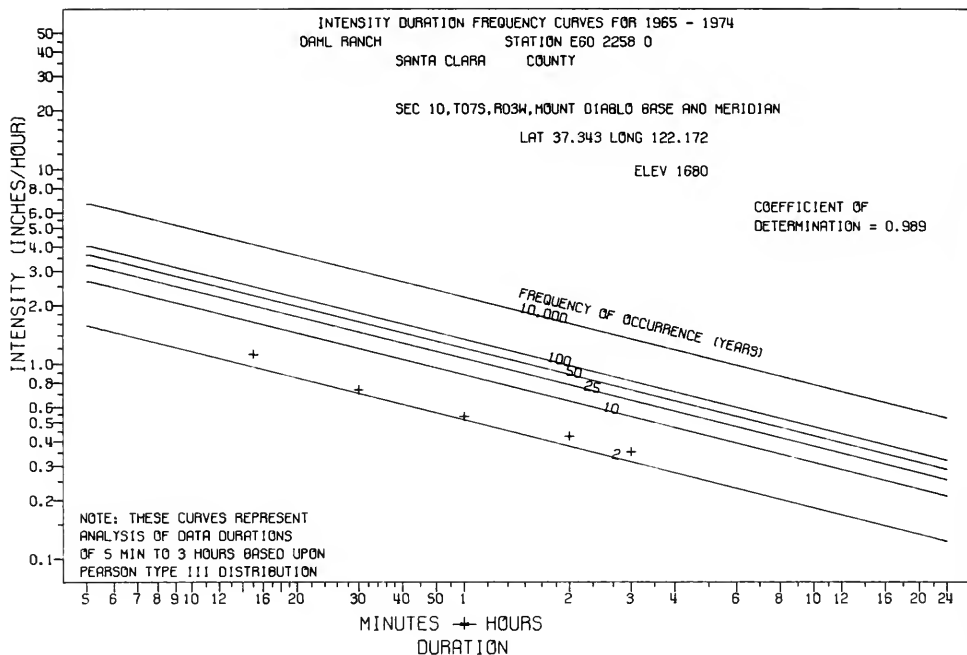


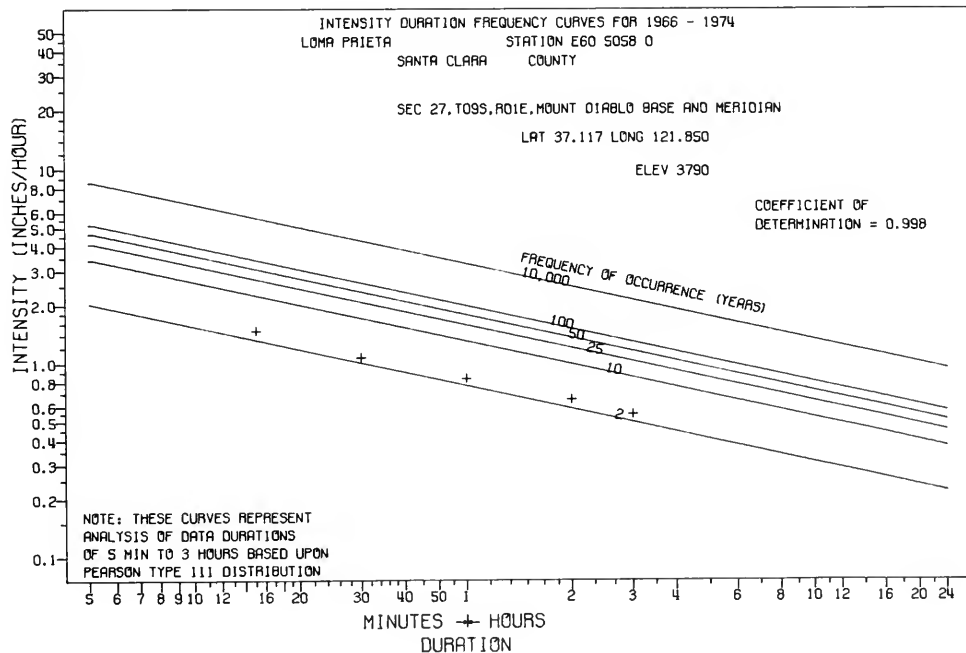
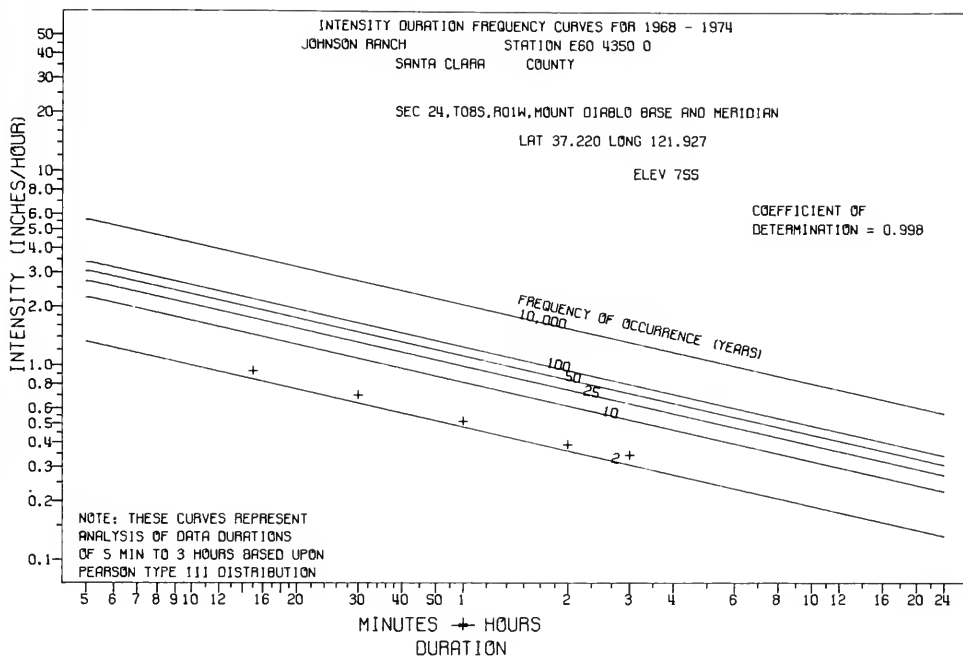


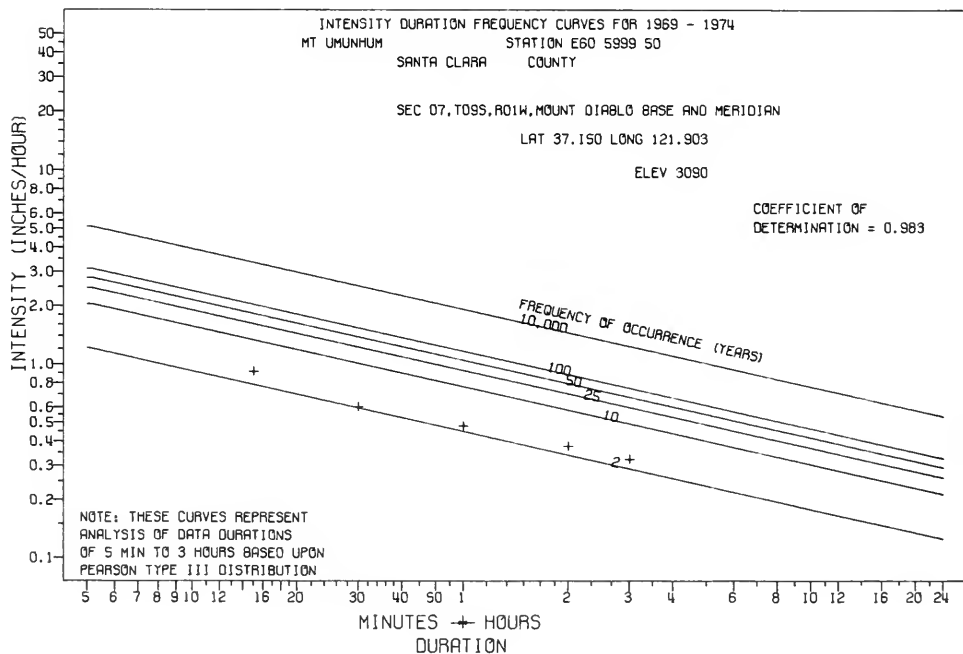
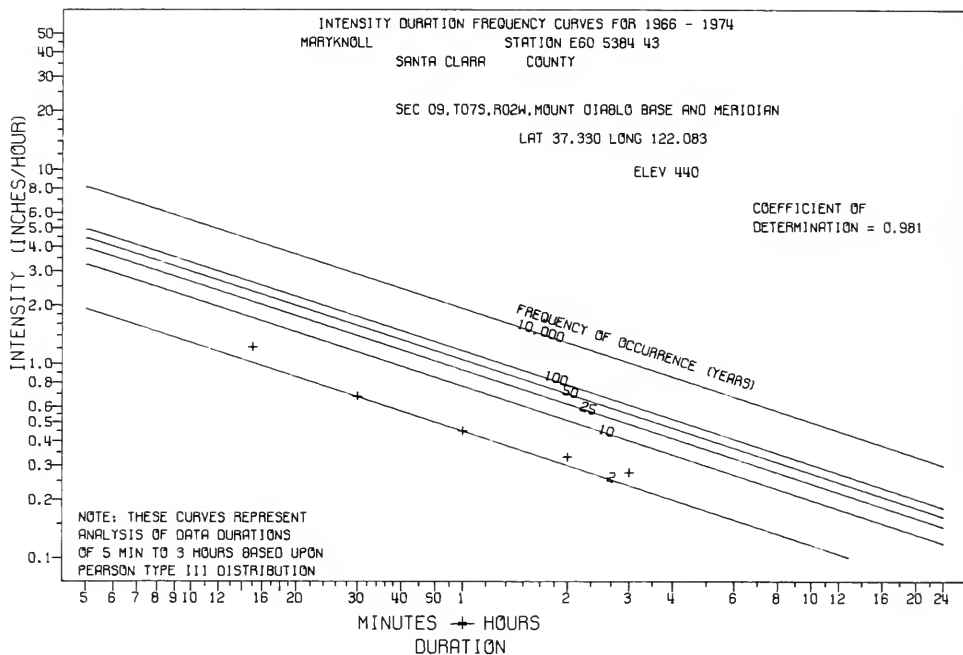


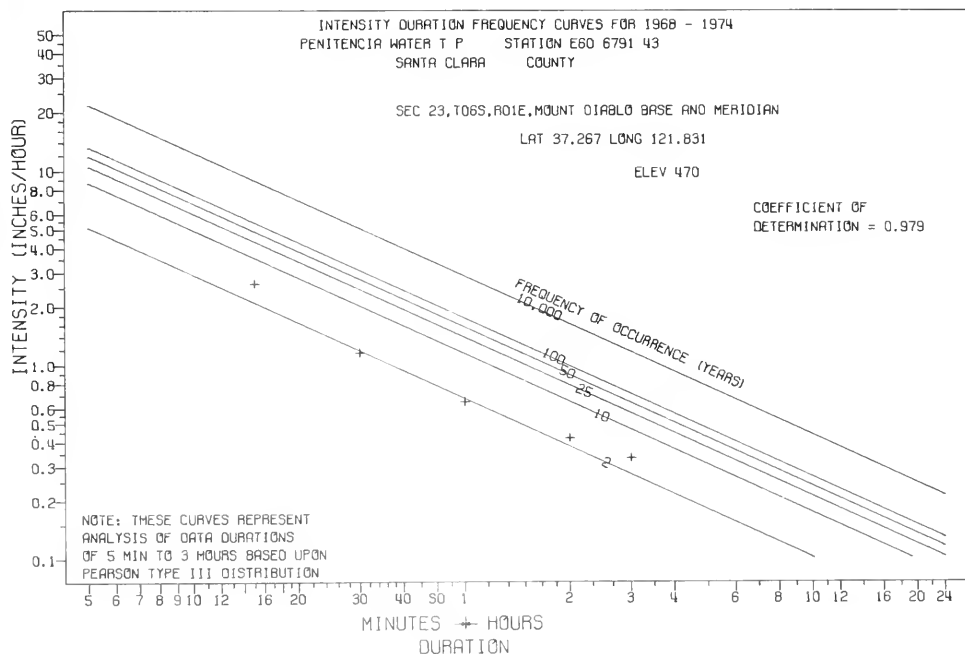
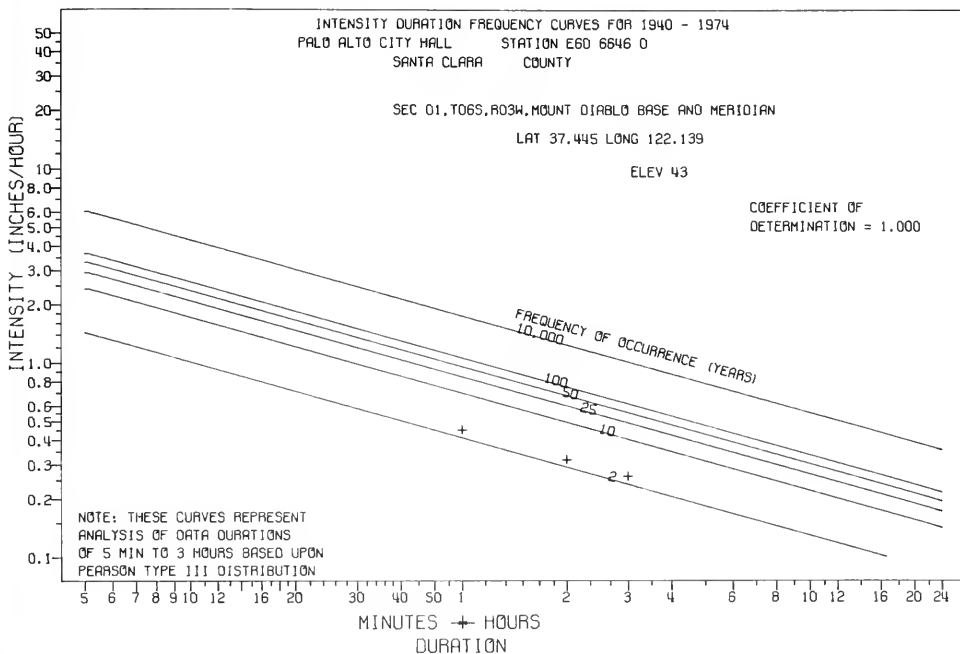


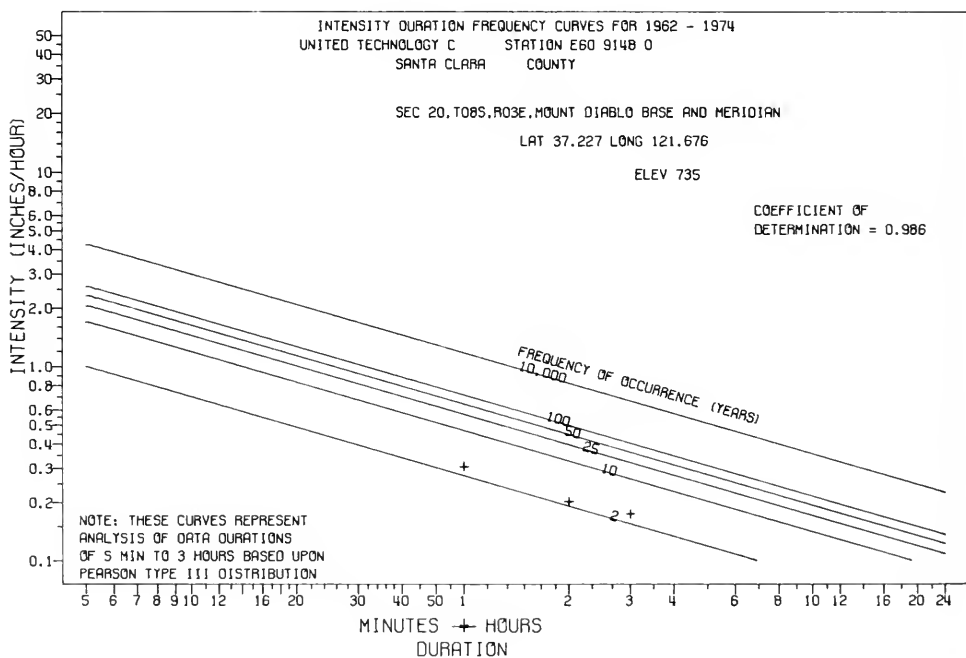
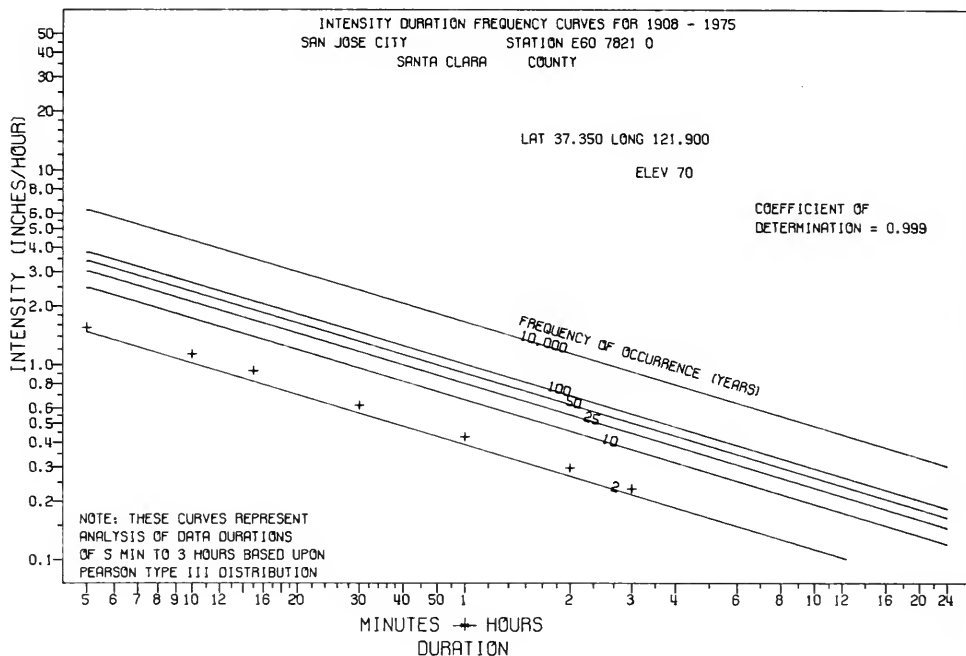


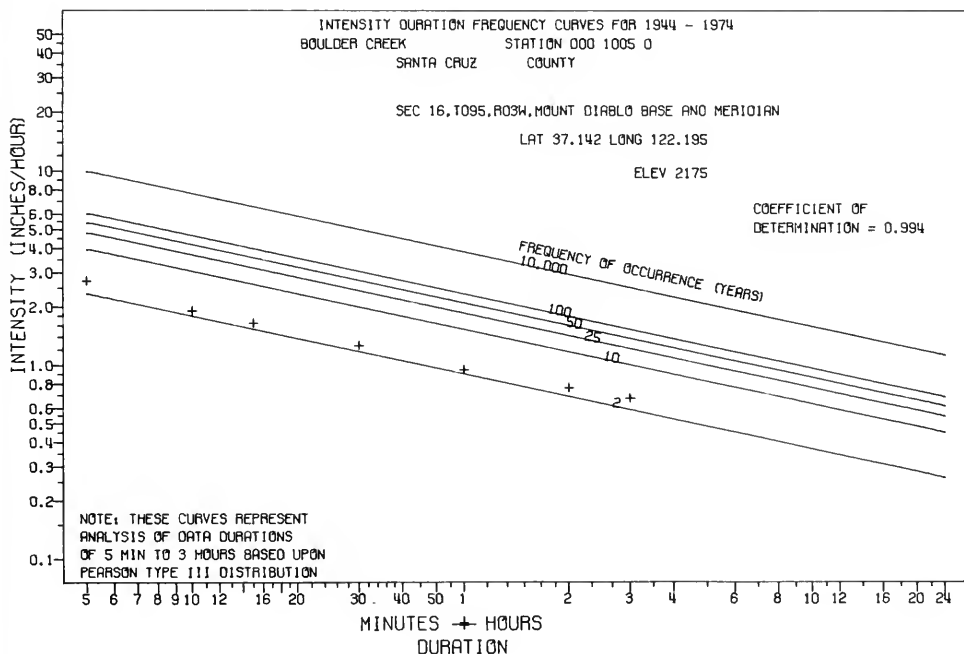
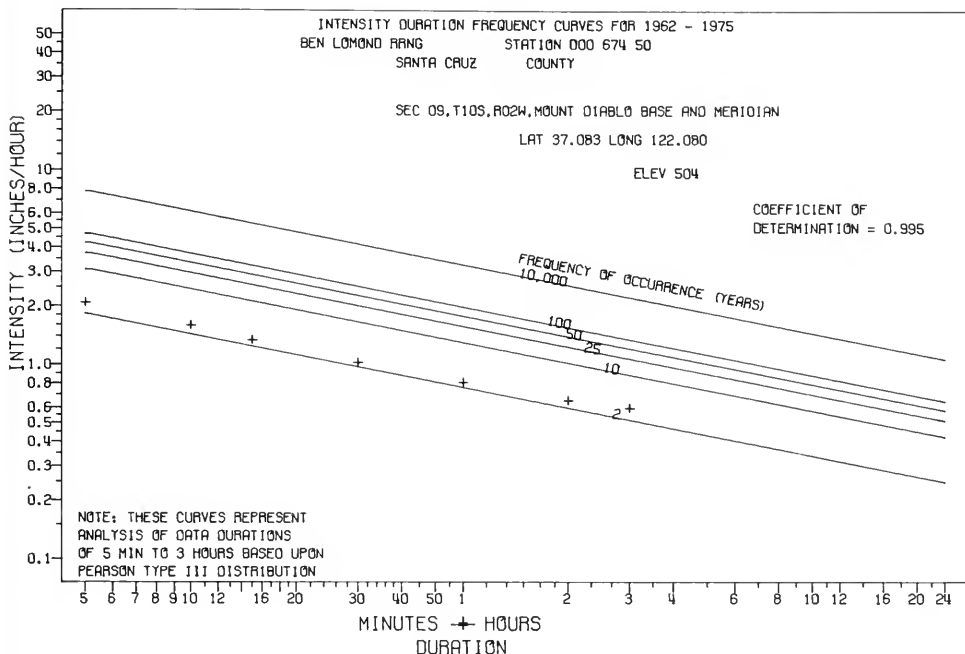


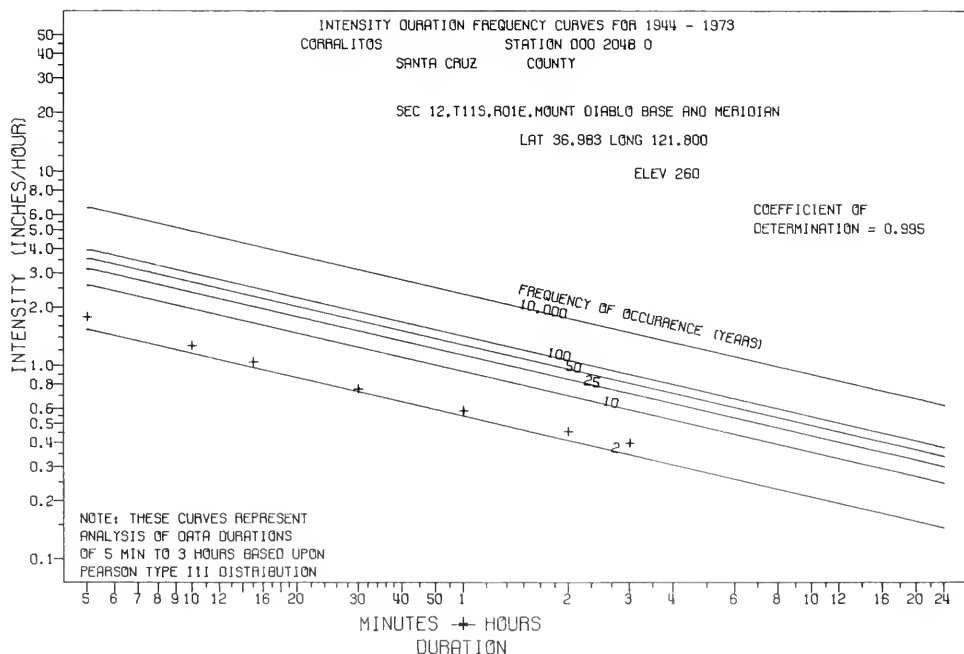
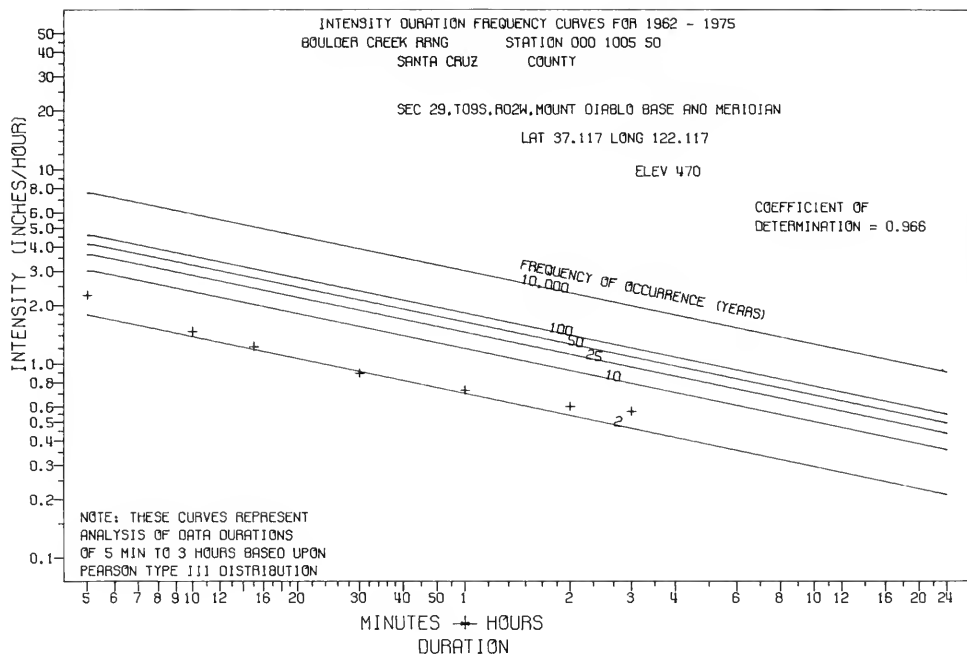


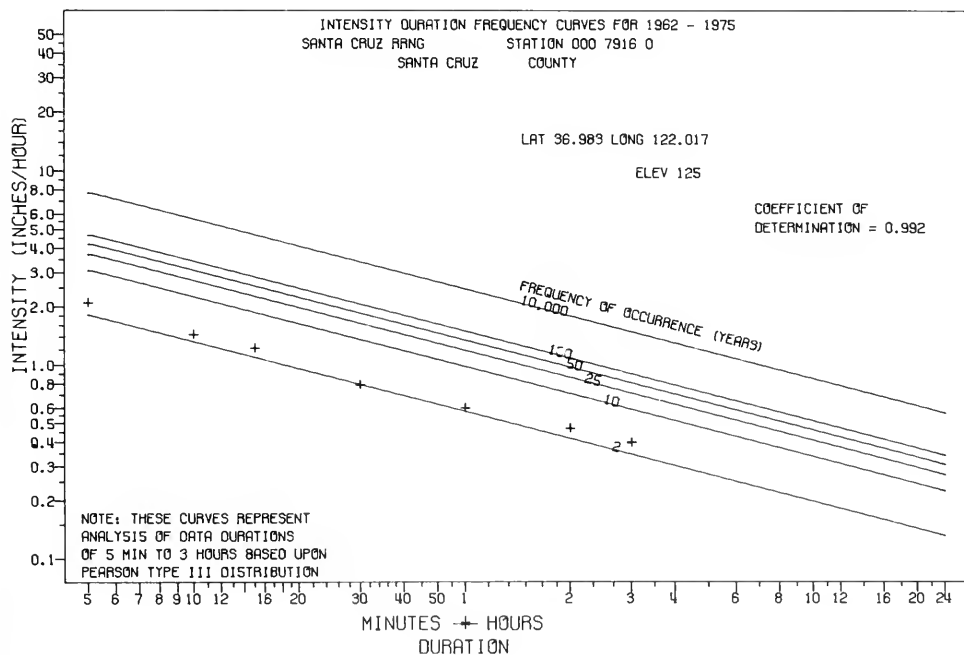
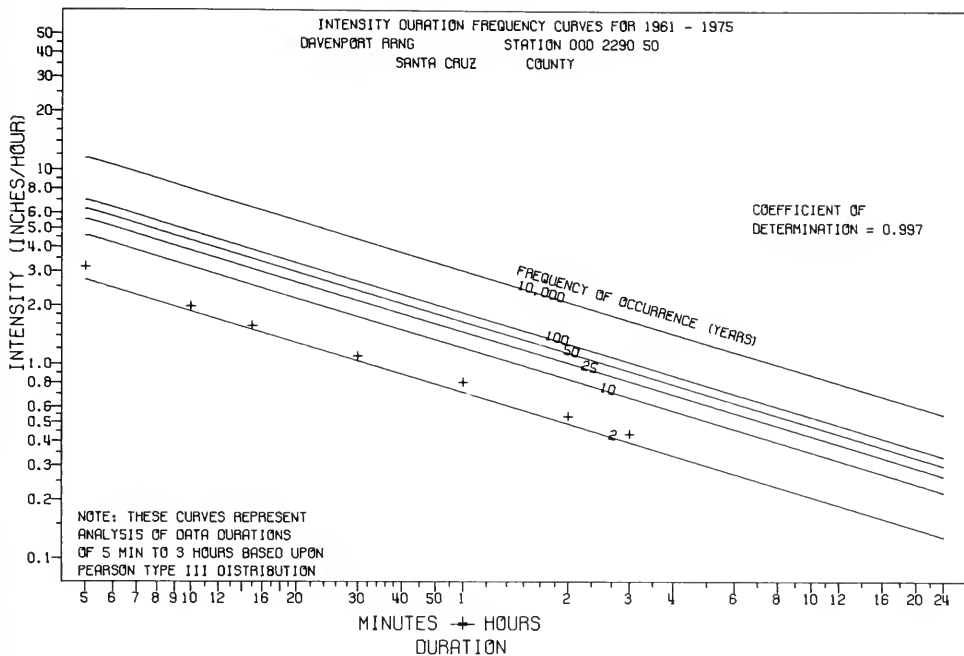


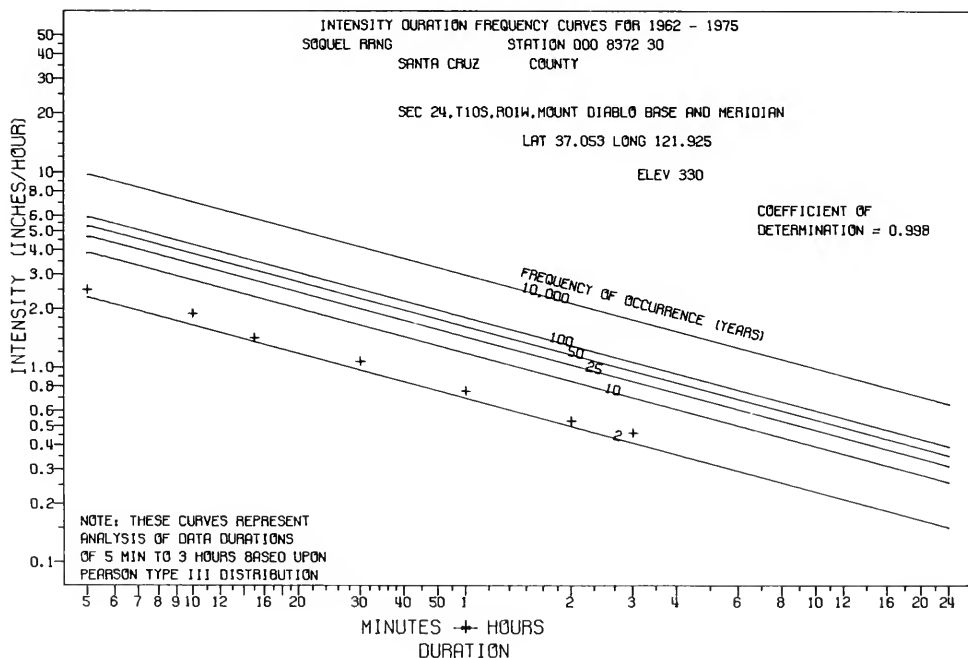
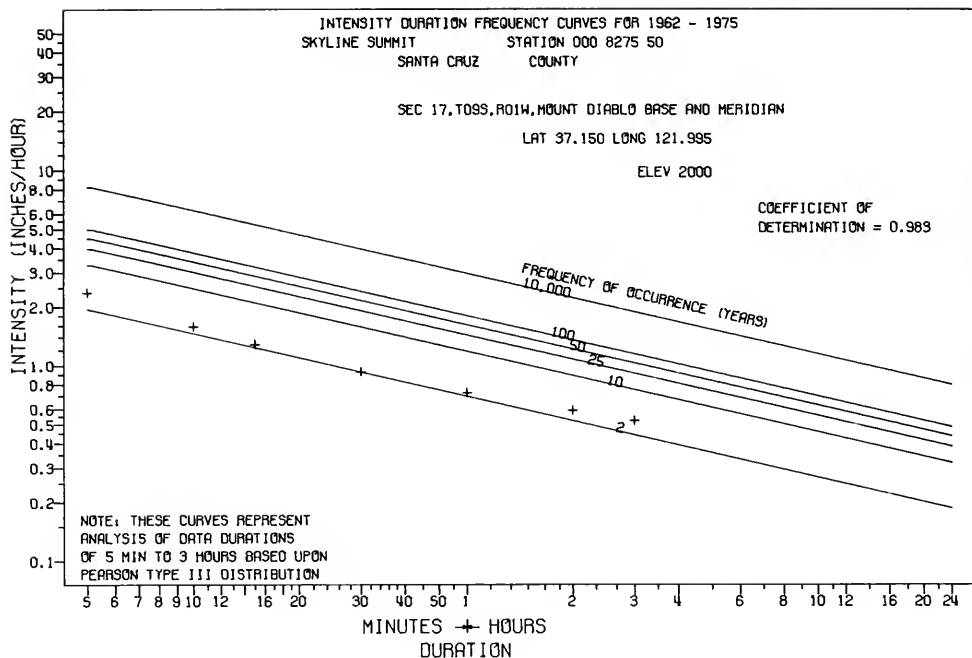


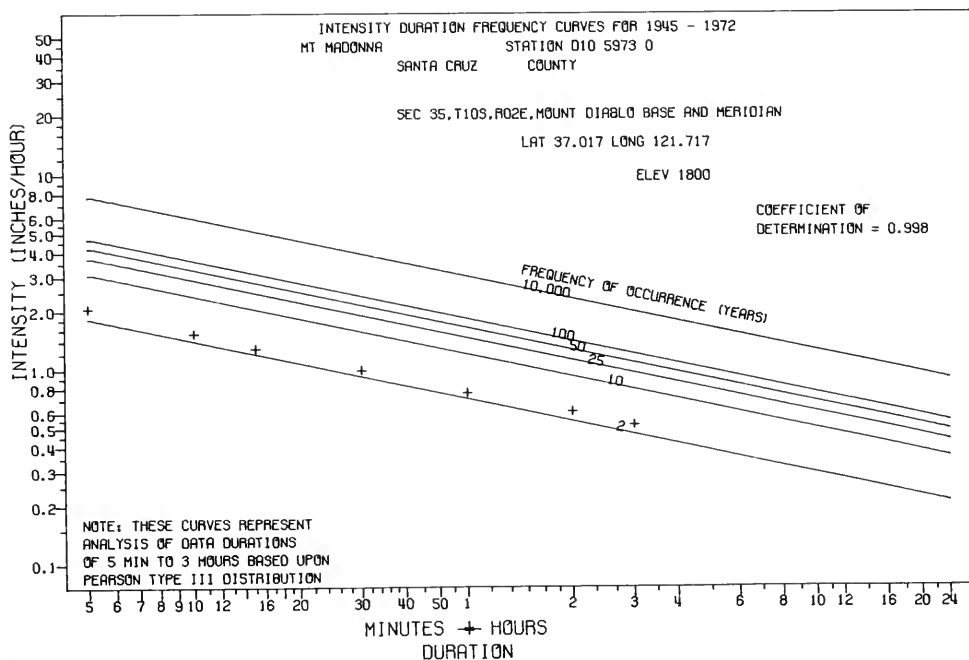
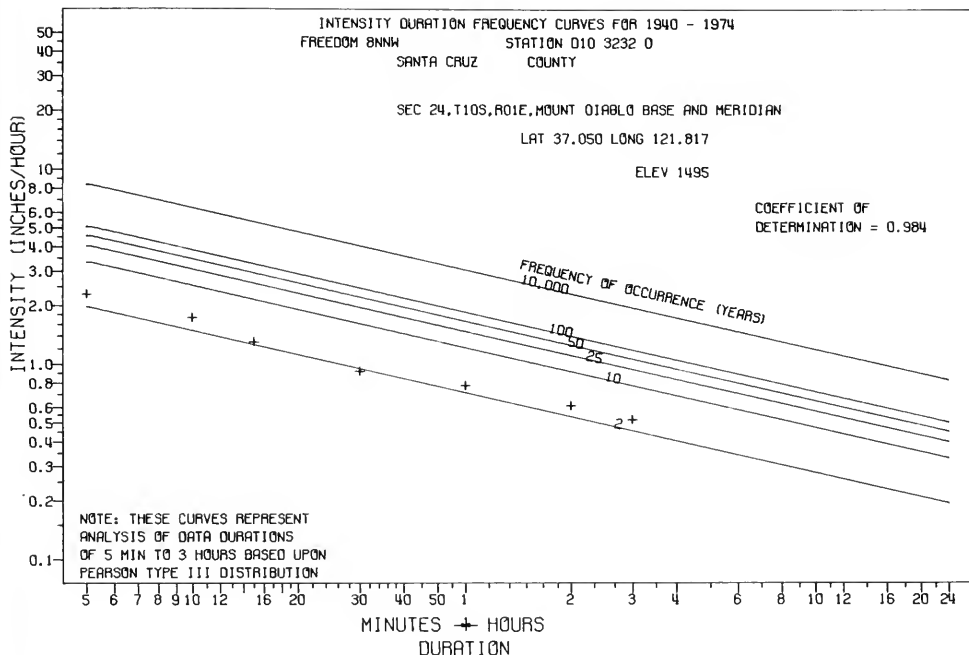


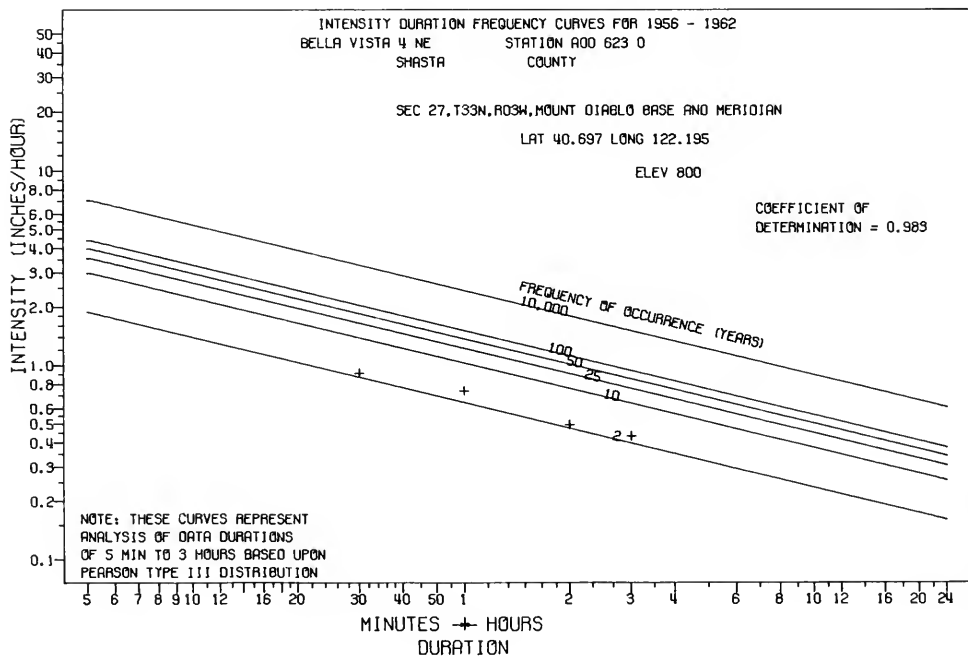
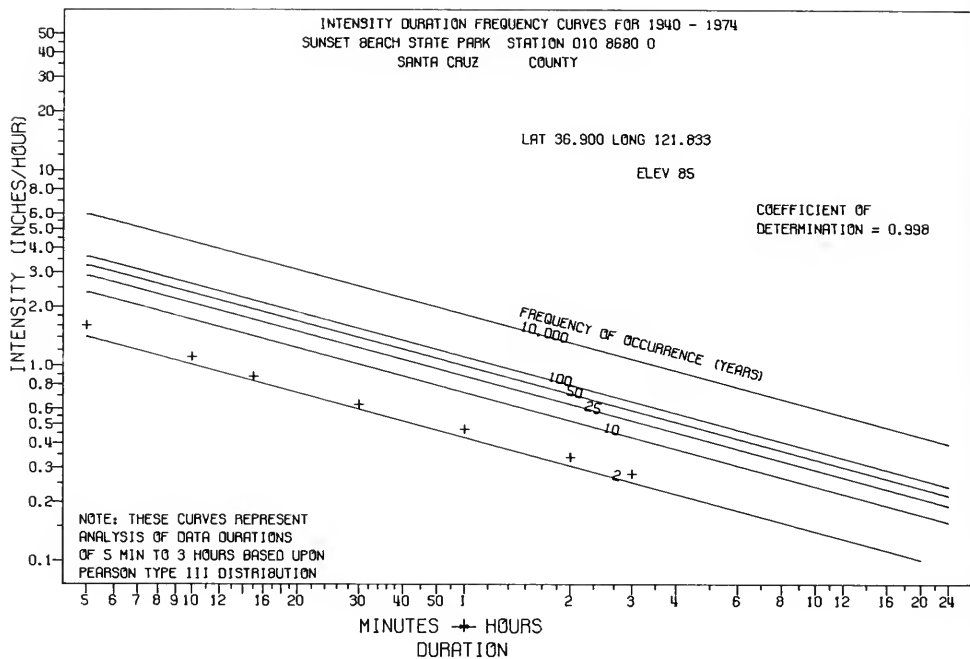


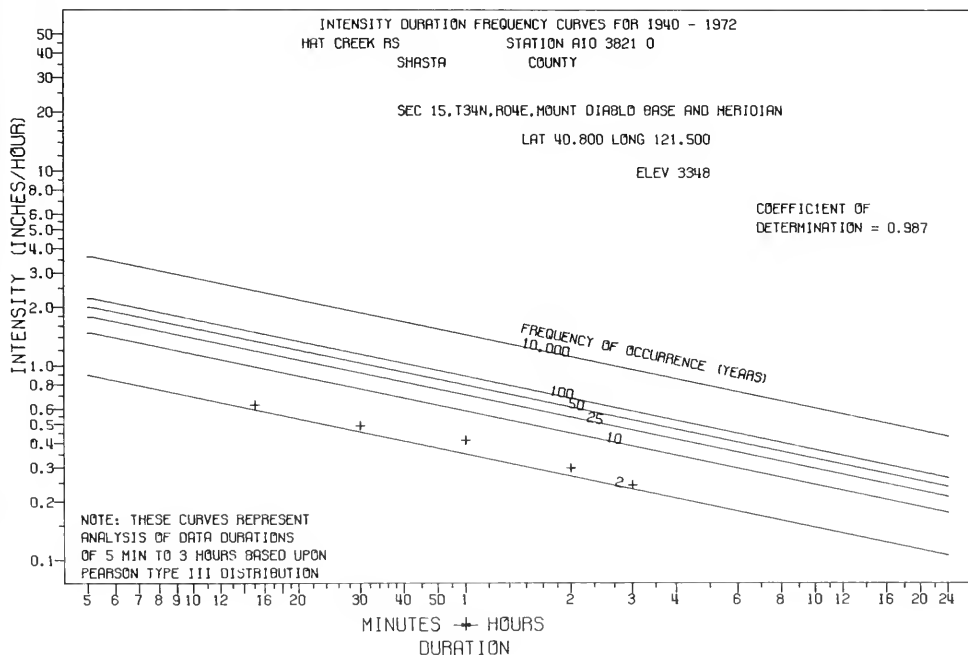
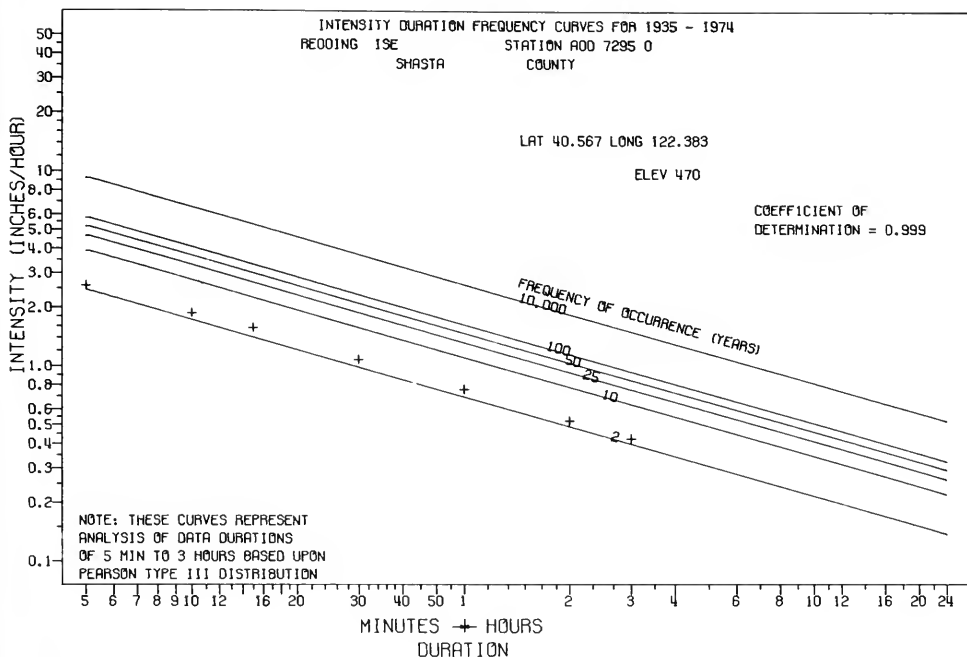


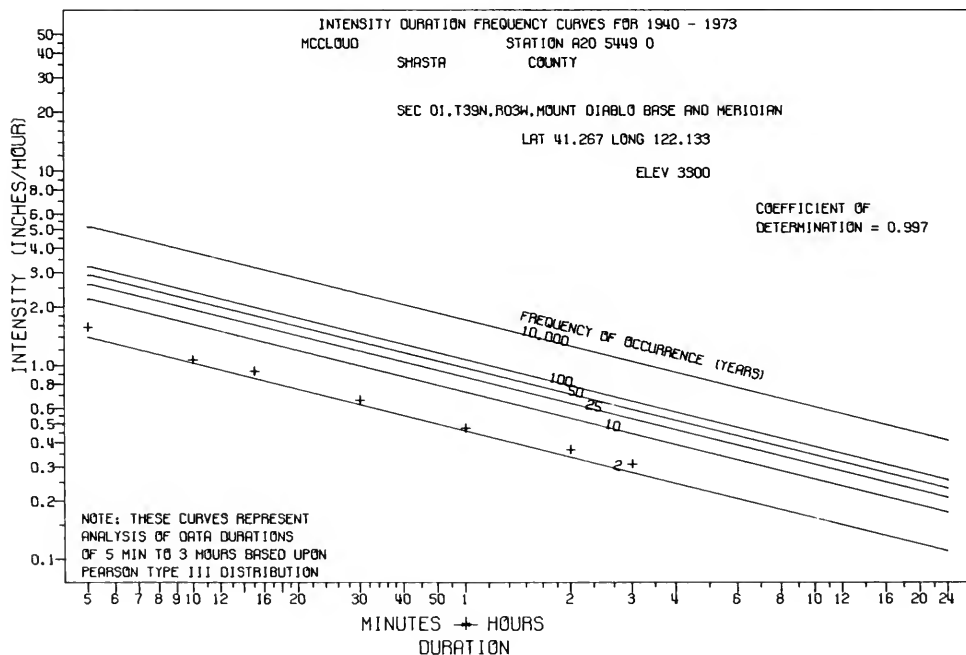
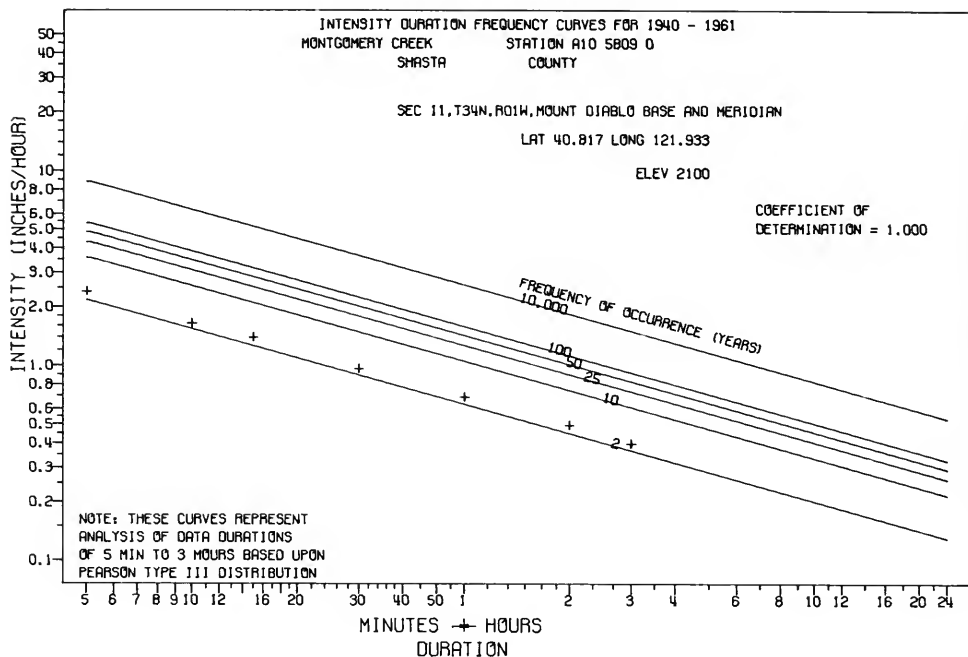


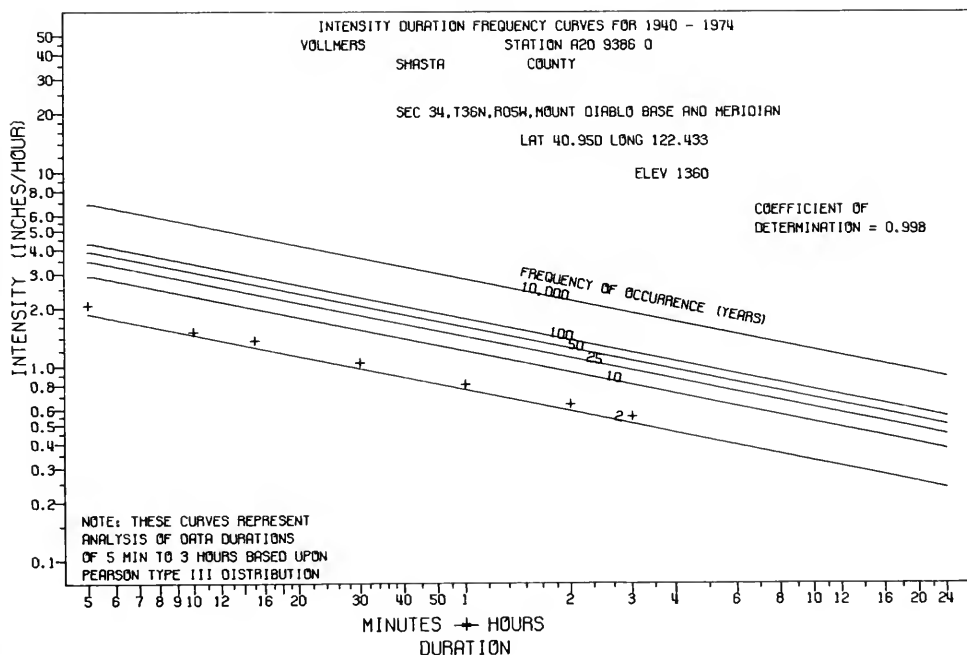
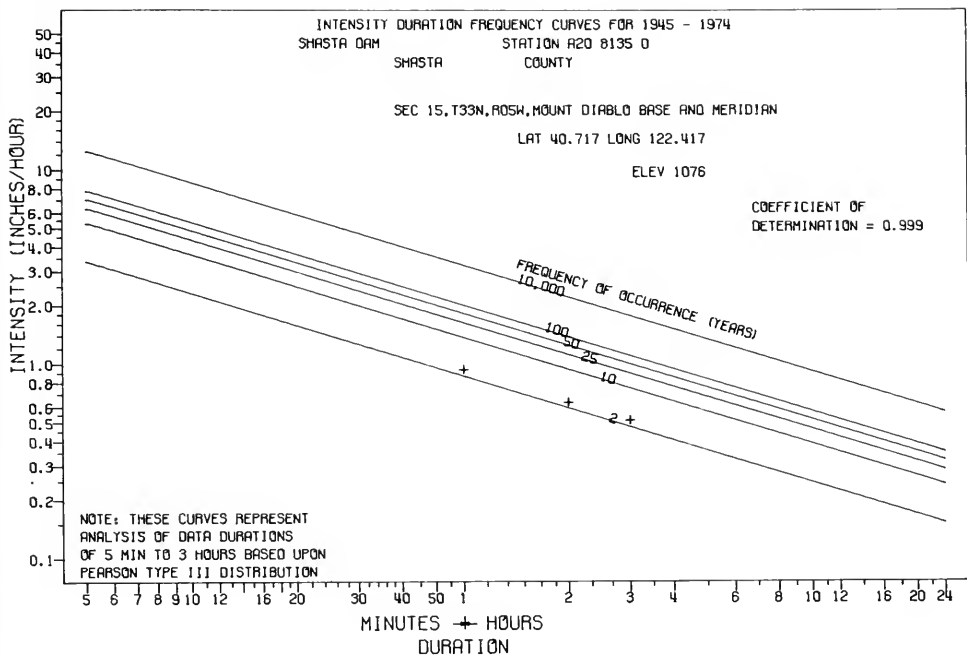


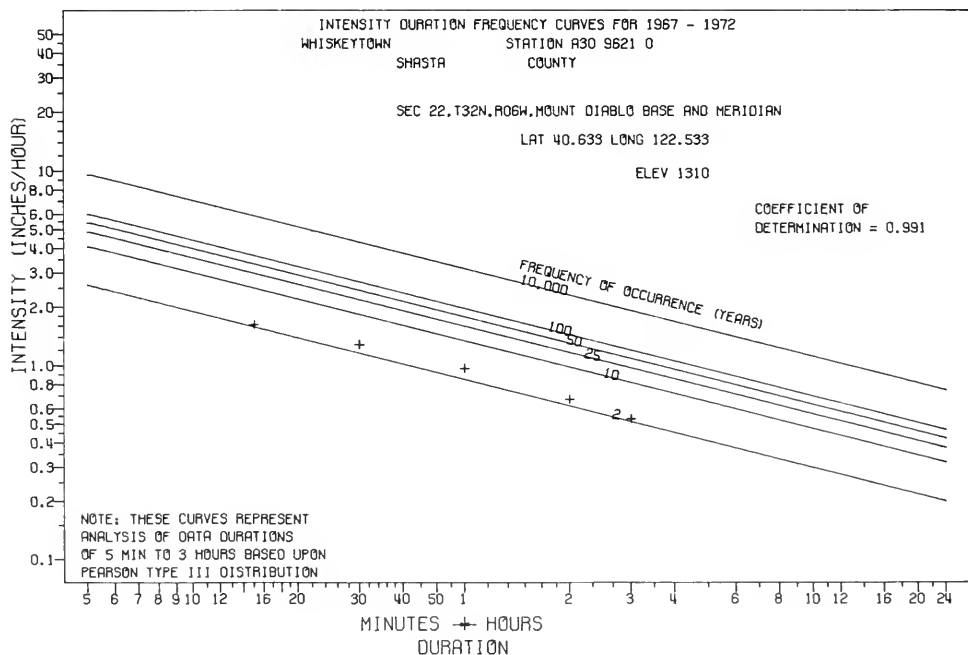
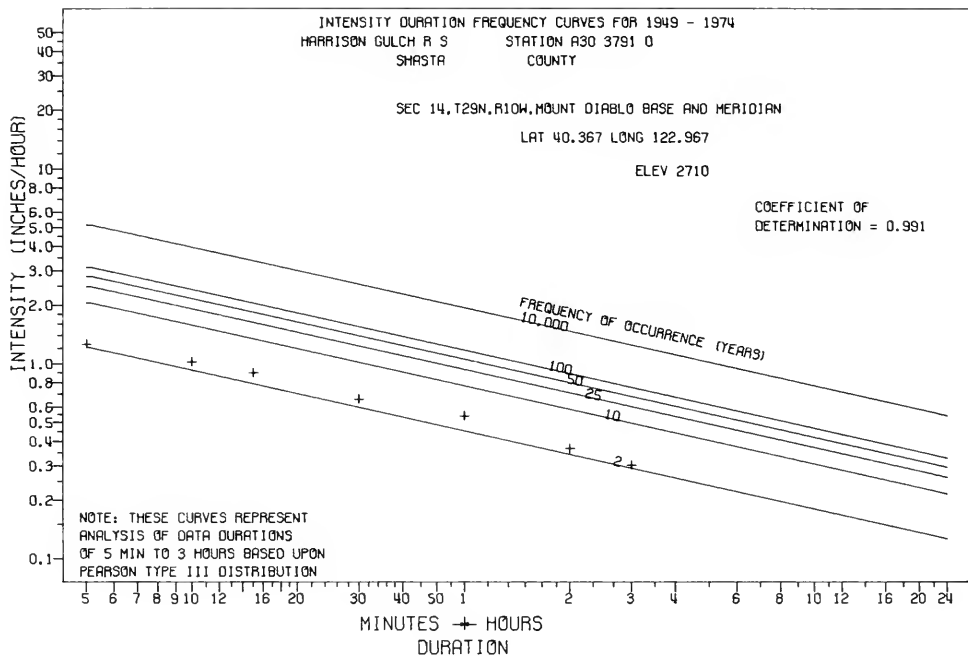


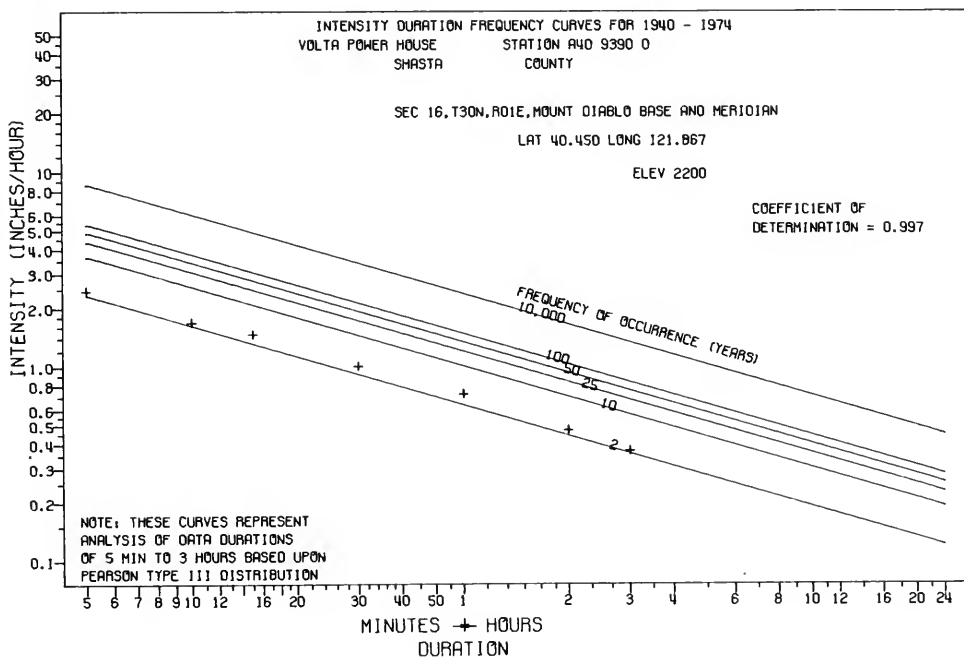
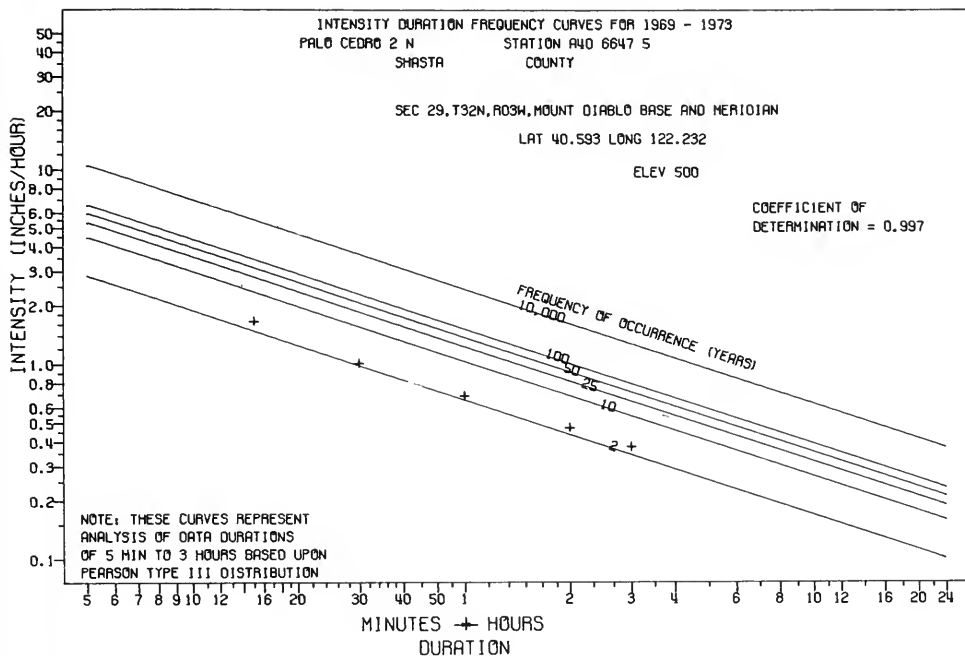


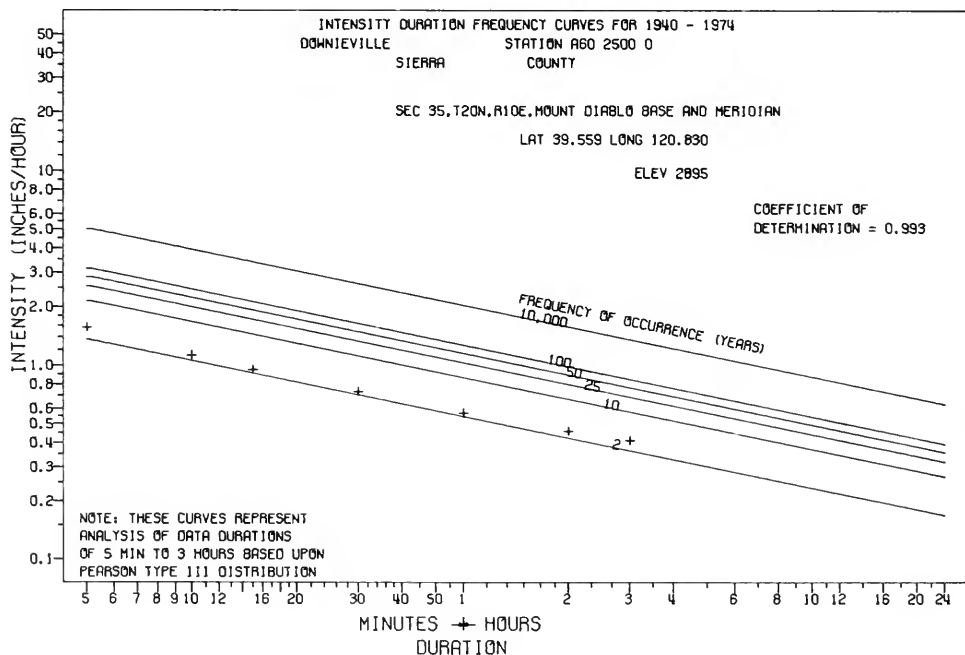
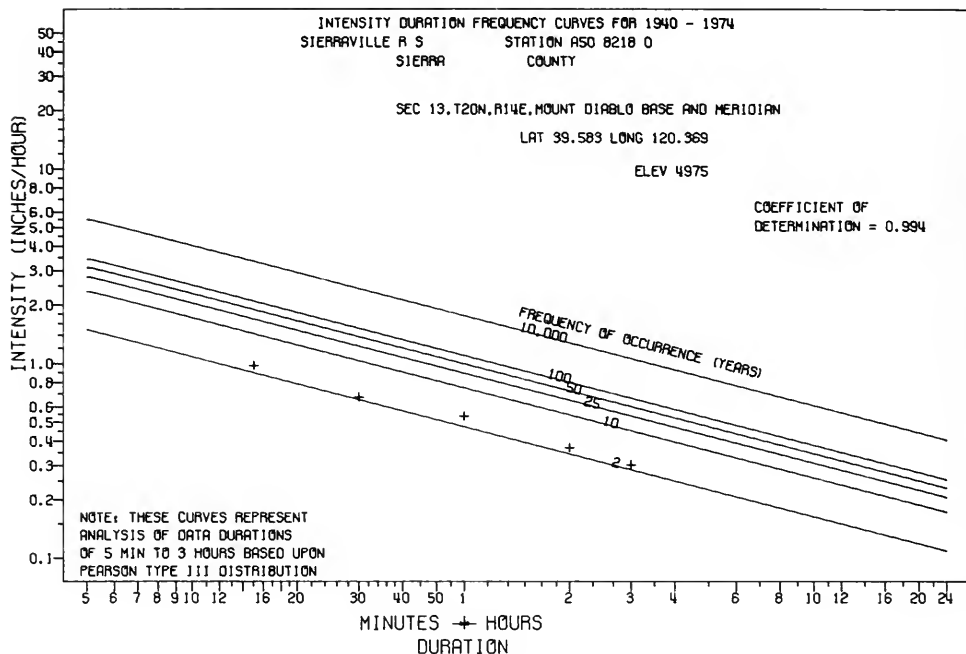












INTENSITY DURATION FREQUENCY CURVES FOR 1940 - 1975
MOUNT SHASTA CITY N W 5 STATION A20 5983 0
SISKIYOU COUNTY

LAT 41.317 LONG 122.317

ELEV 3540

COEFFICIENT OF
DETERMINATION = 0.998

INTENSITY (INCHES/HOUR)

FREQUENCY OF OCCURRENCE (YEARS)

NOTE: THESE CURVES REPRESENT
ANALYSIS OF DATA DURATIONS
OF 5 MIN TO 3 HOURS BASED UPON
PEARSON TYPE III DISTRIBUTION

MINUTES + HOURS
DURATION

INTENSITY DURATION FREQUENCY CURVES FOR 1941 - 1974
TULELAKE STATION F10 9053 0
SISKIYOU COUNTY

SEC 06, T47N, R05E, MOUNT DIABLO BASE AND MERIDIAN

LAT 41.967 LONG 121.467

ELEV 4035

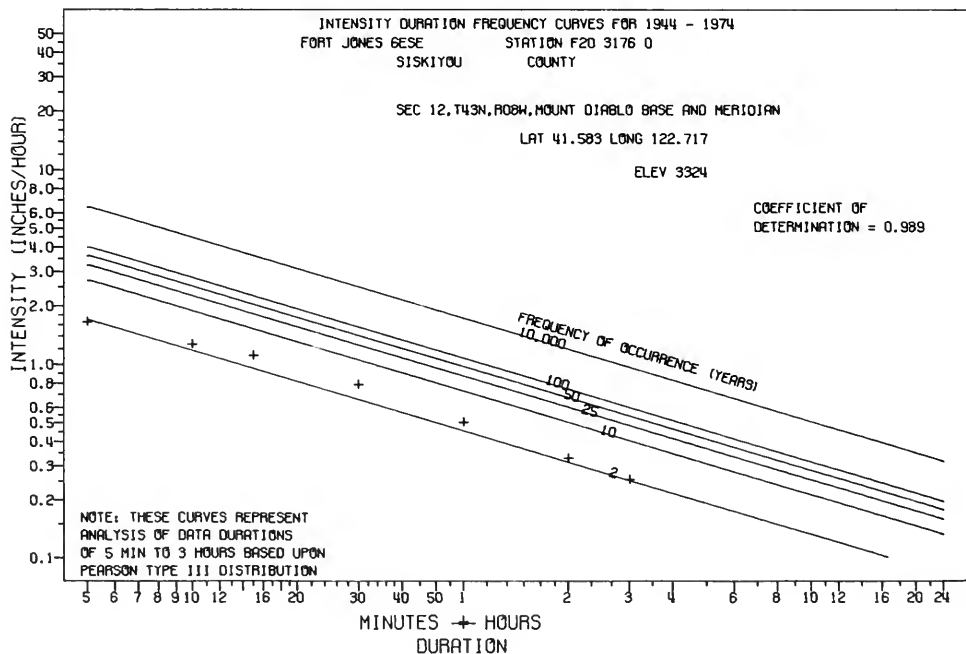
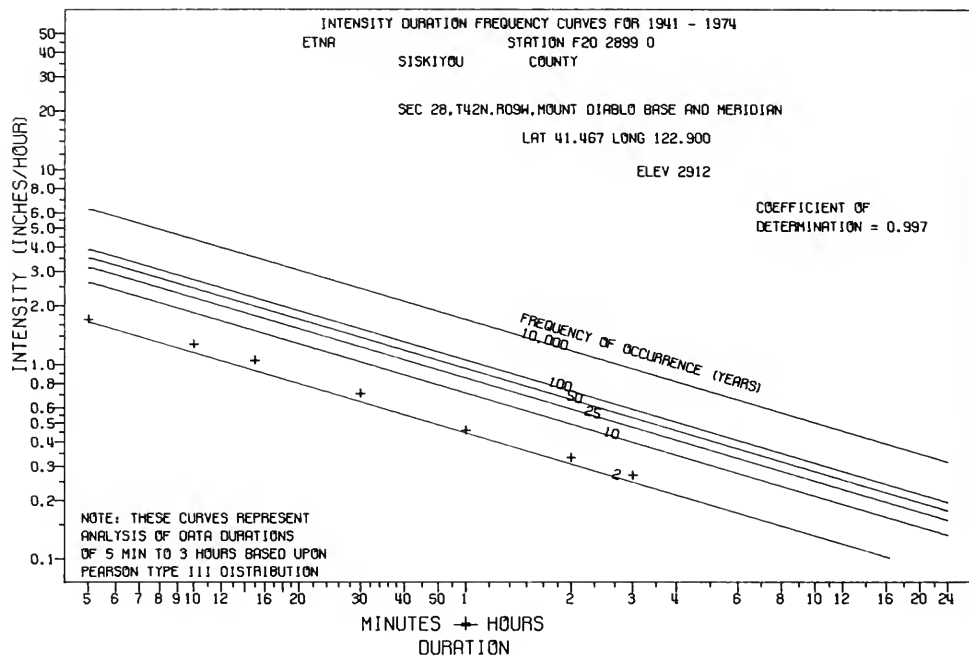
COEFFICIENT OF
DETERMINATION = 0.991

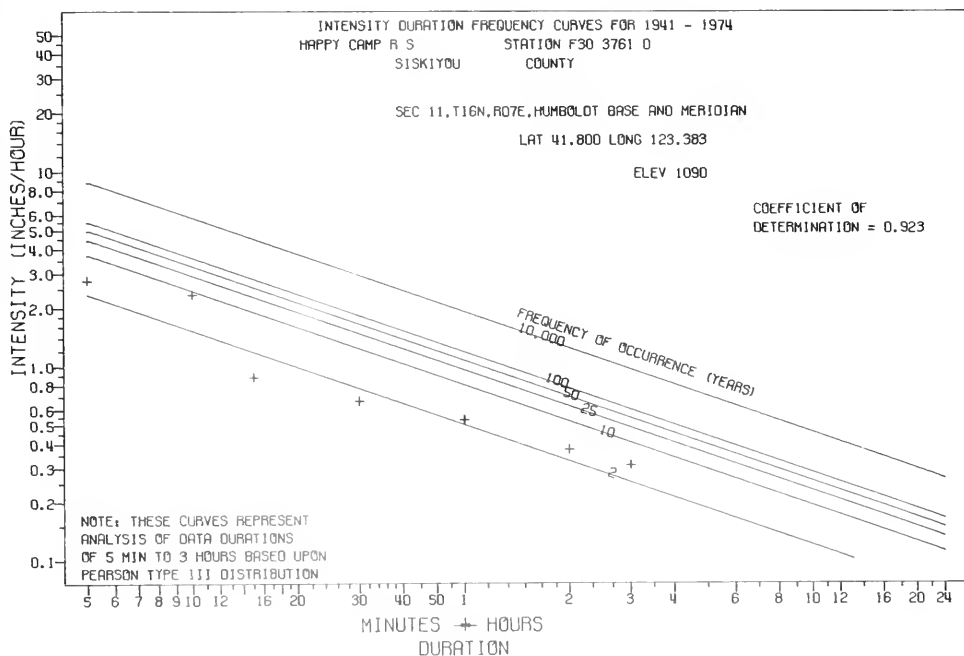
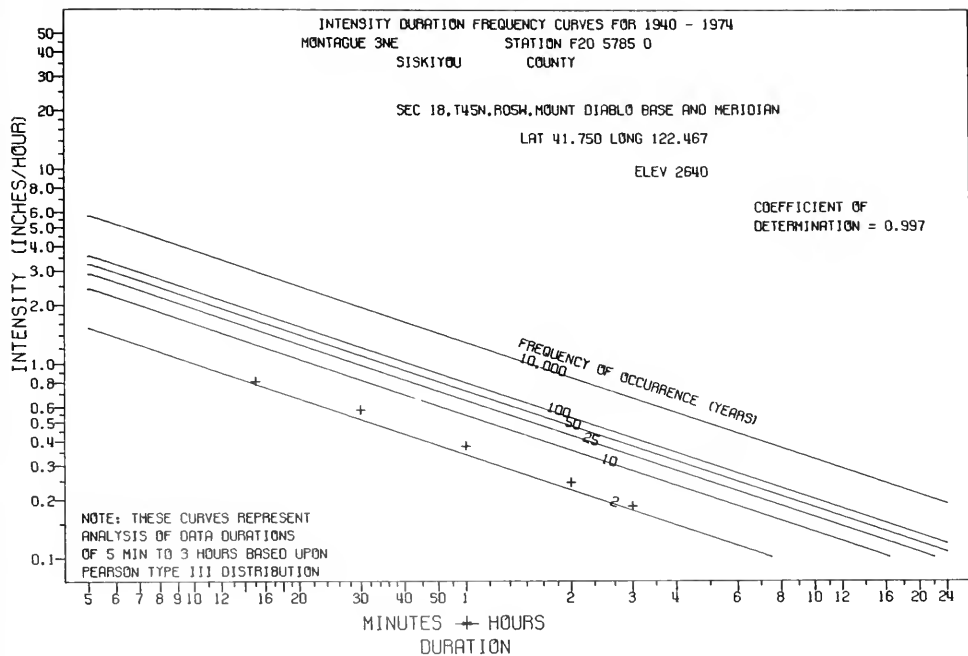
INTENSITY (INCHES/HOUR)

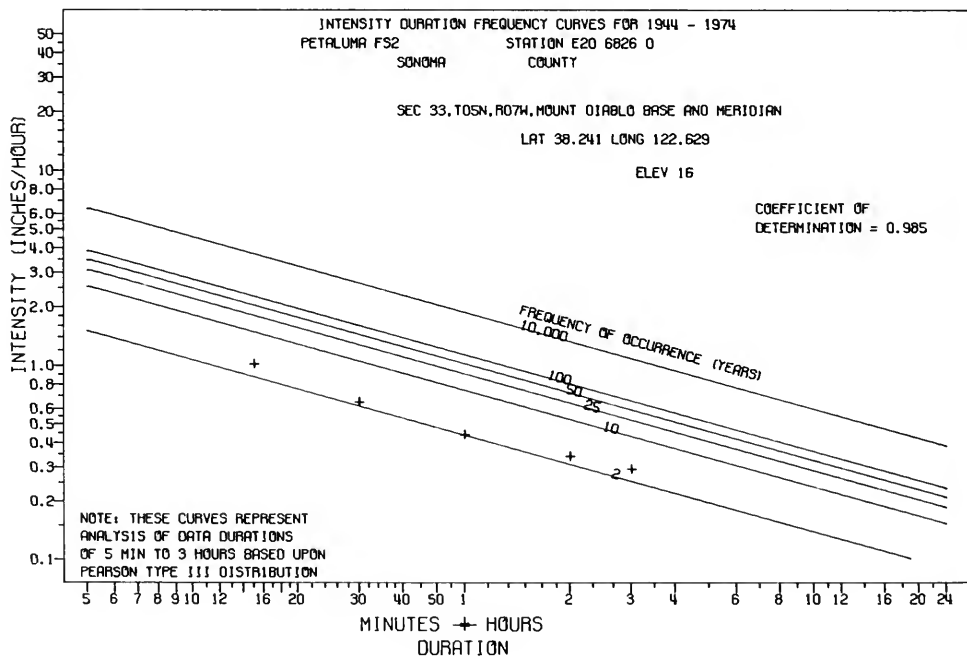
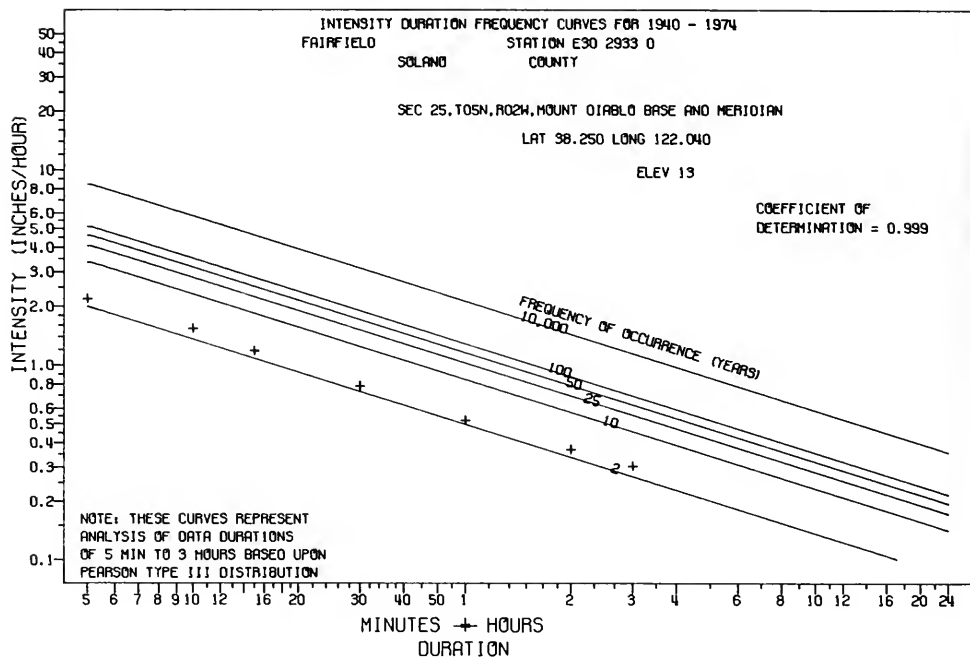
FREQUENCY OF OCCURRENCE (YEARS)

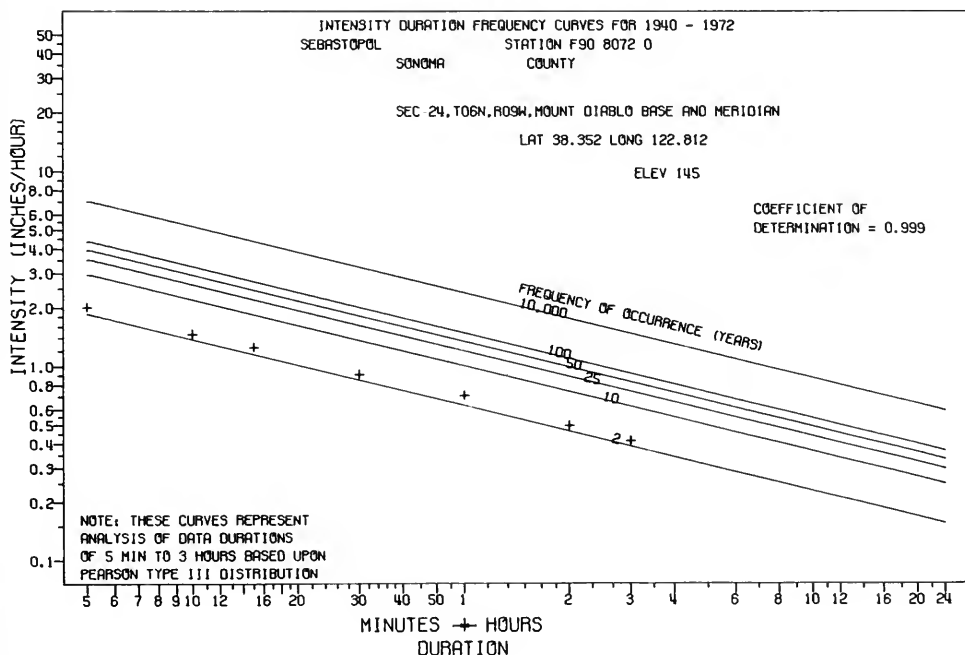
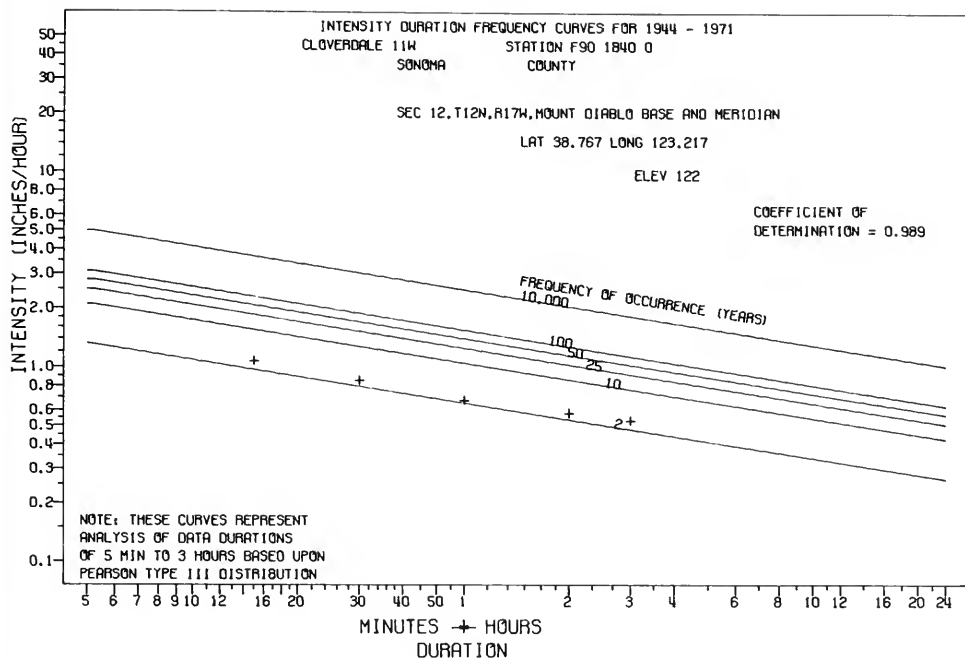
NOTE: THESE CURVES REPRESENT
ANALYSIS OF DATA DURATIONS
OF 5 MIN TO 3 HOURS BASED UPON
PEARSON TYPE III DISTRIBUTION

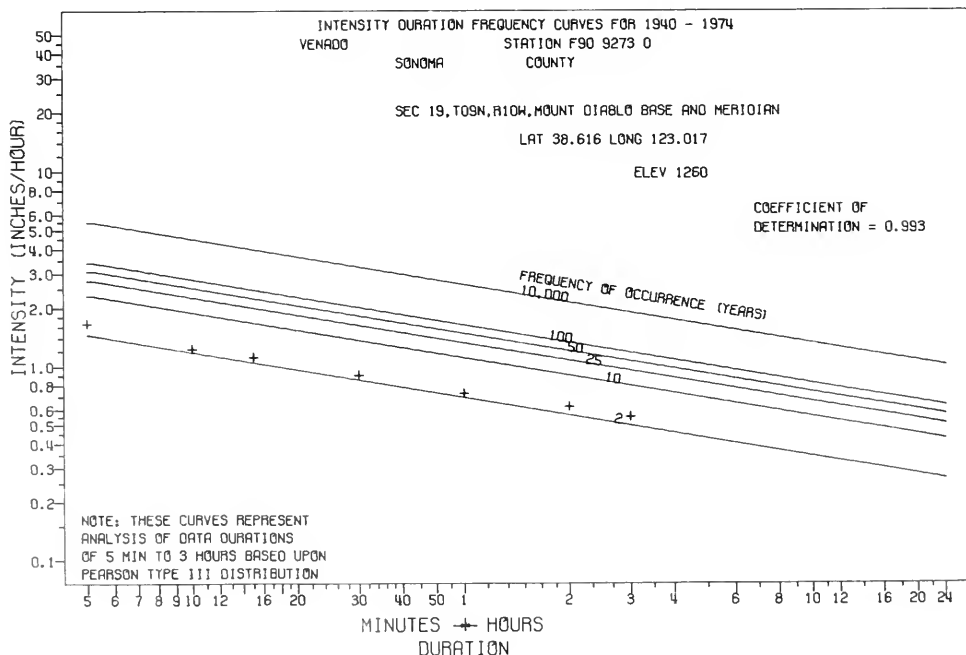
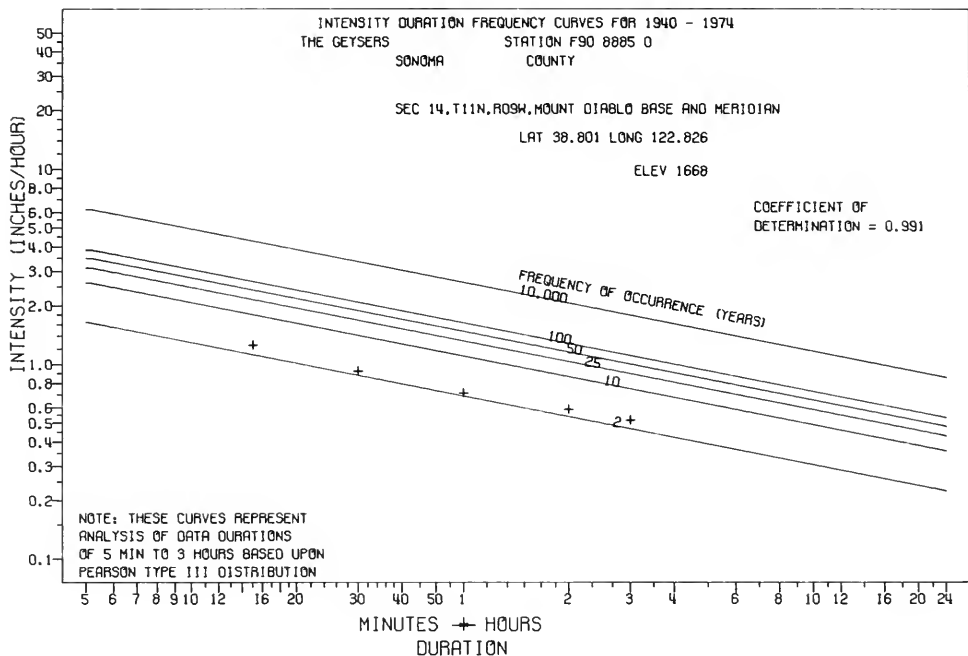
MINUTES + HOURS
DURATION

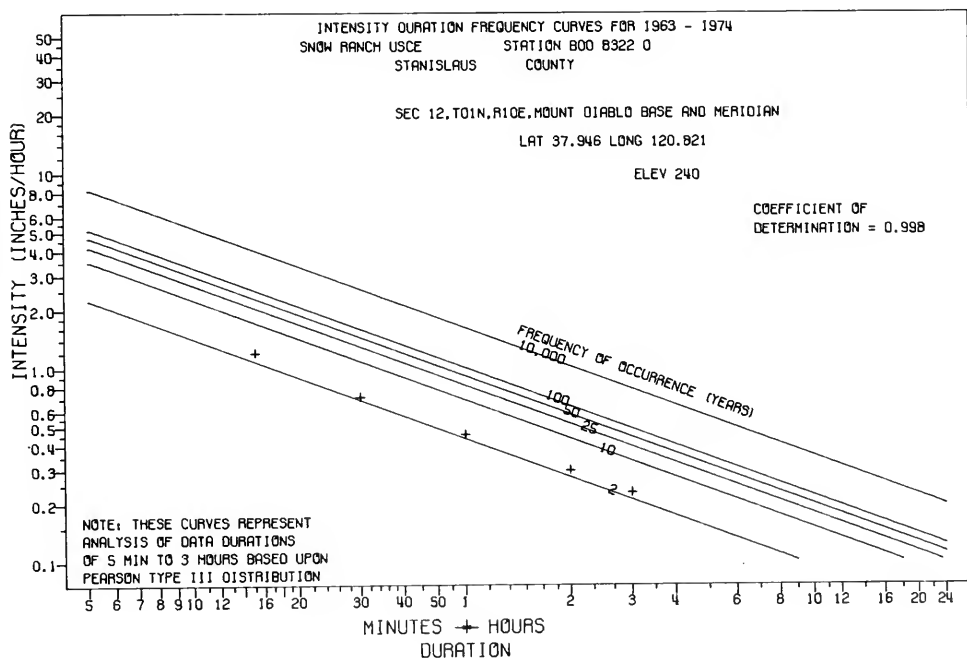
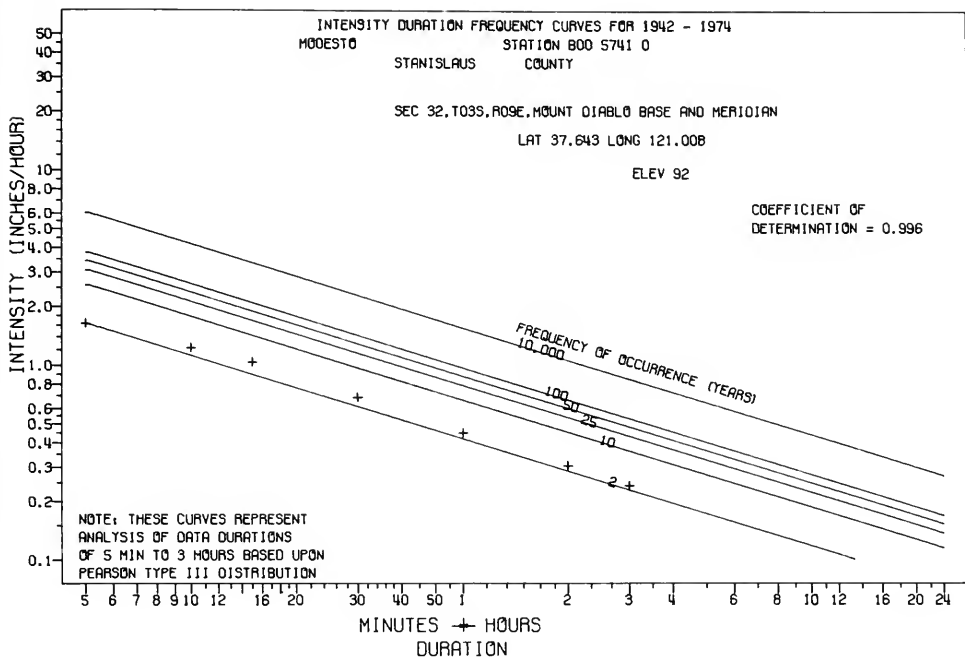


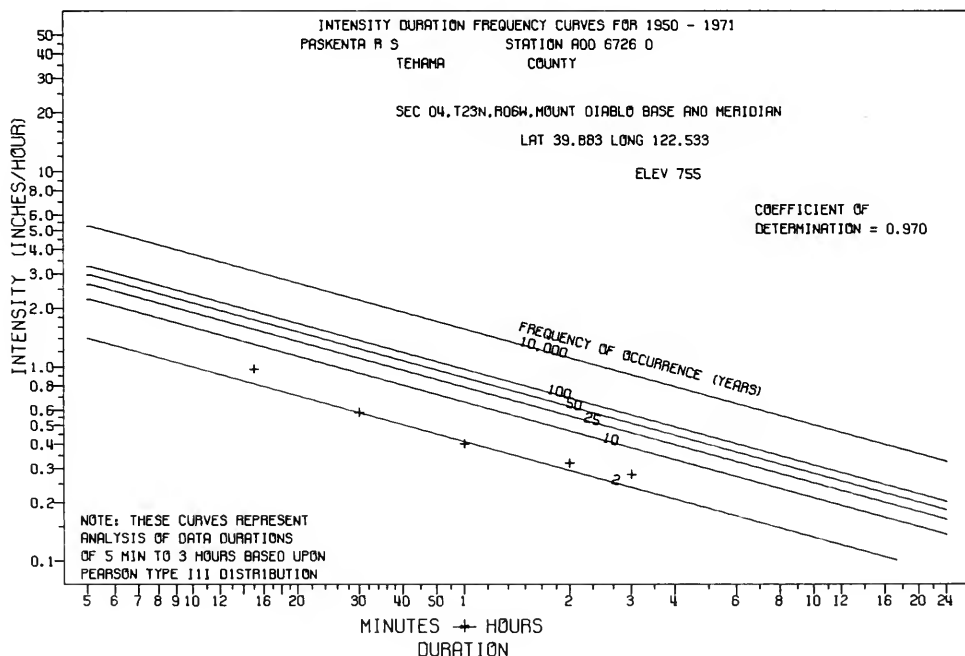
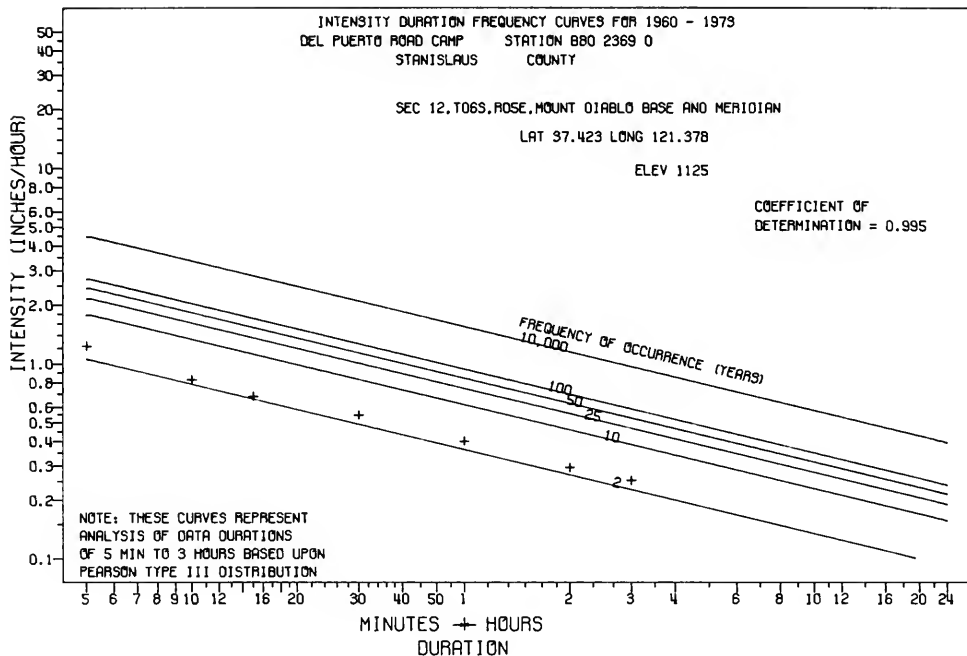


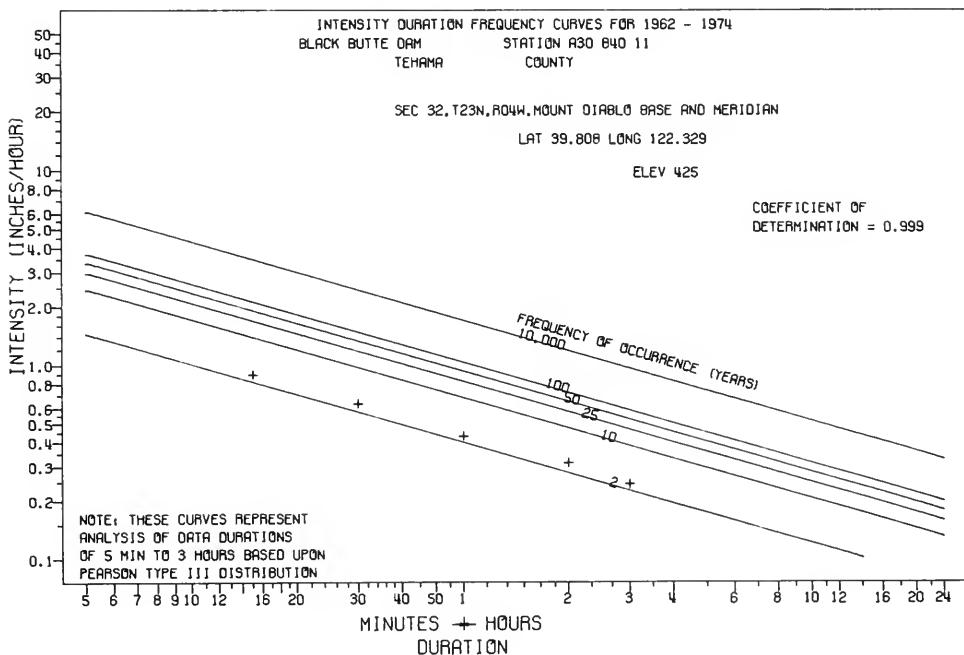
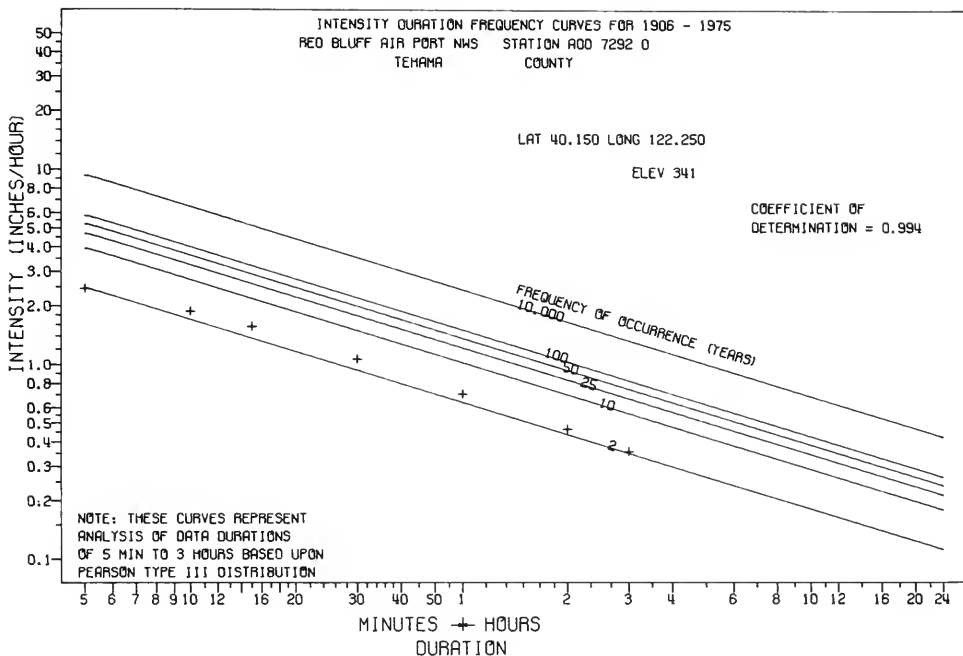


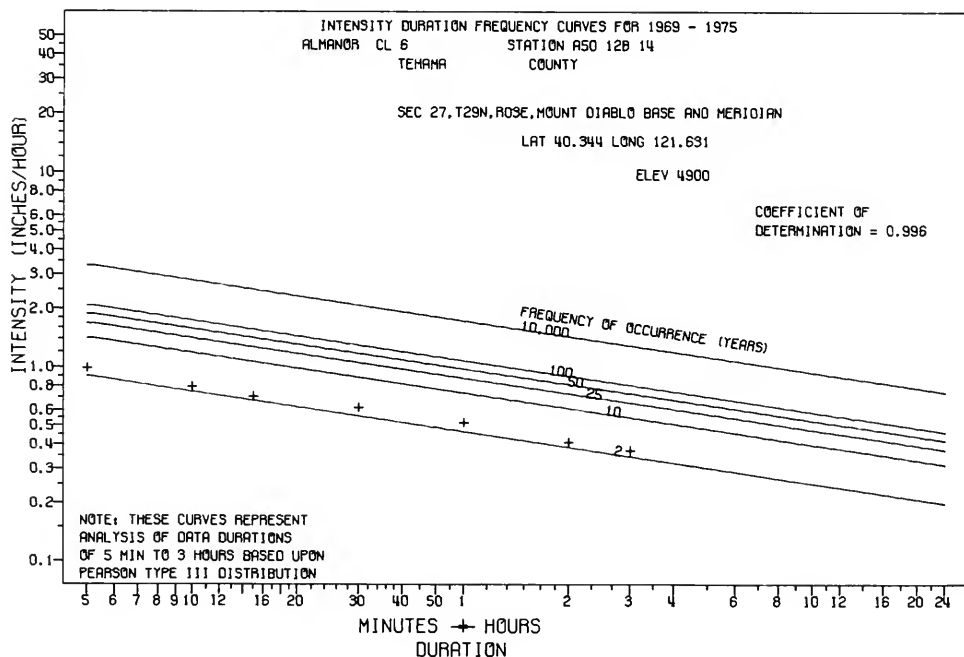
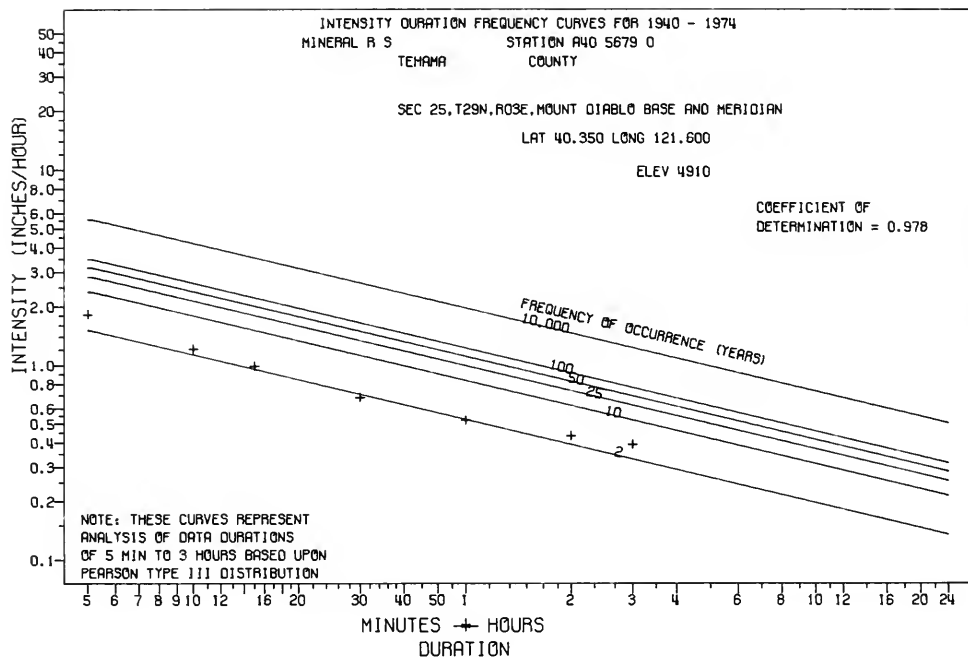


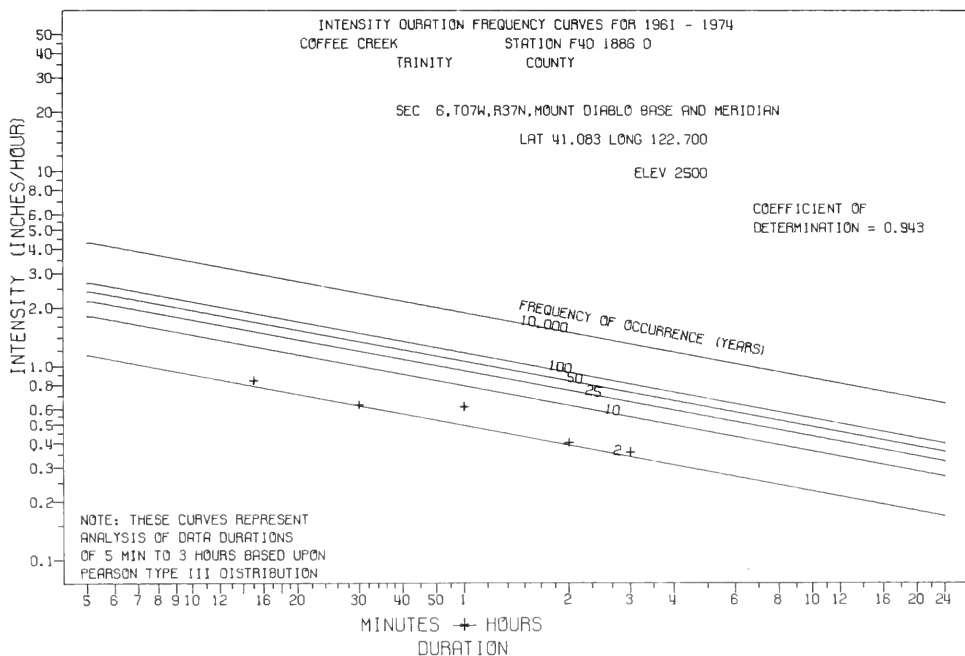
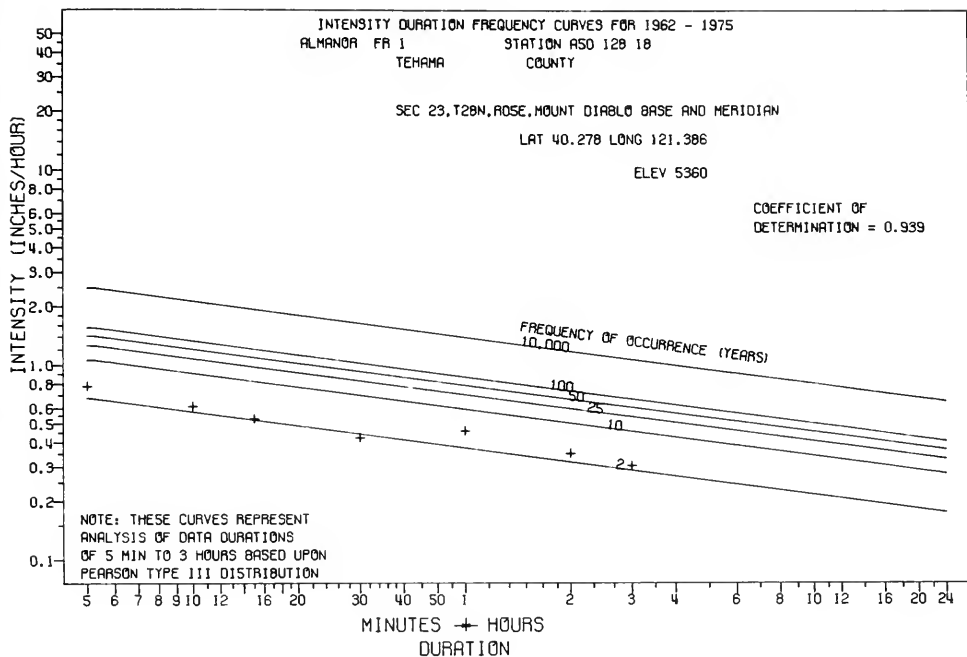


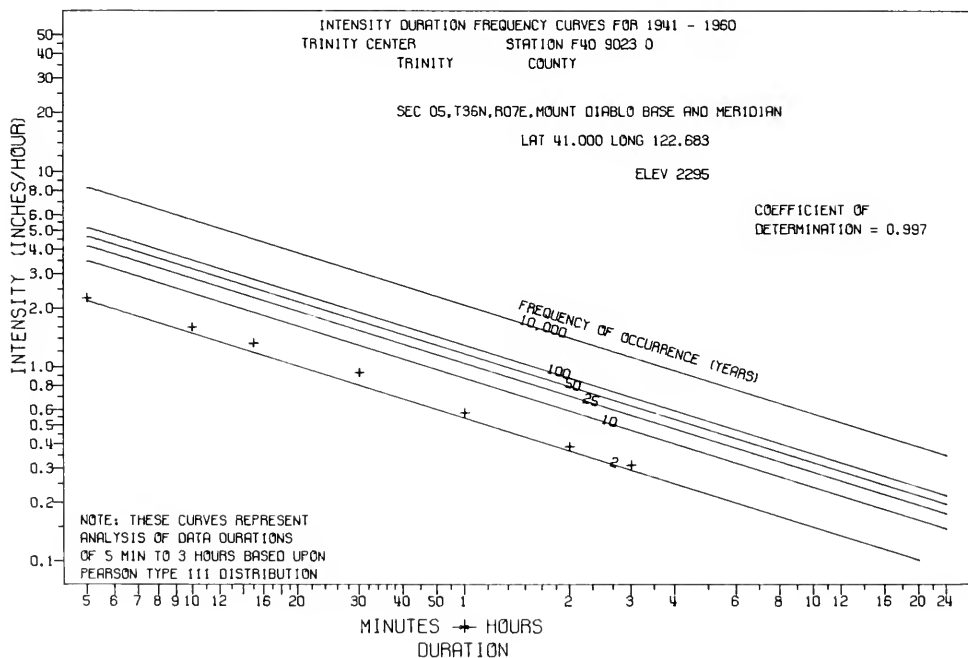
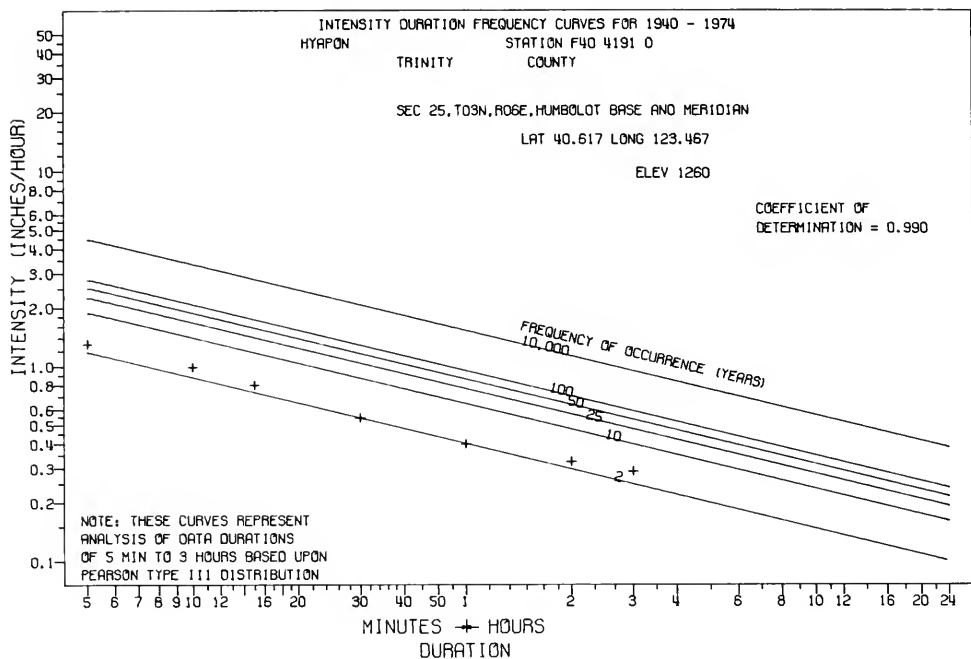


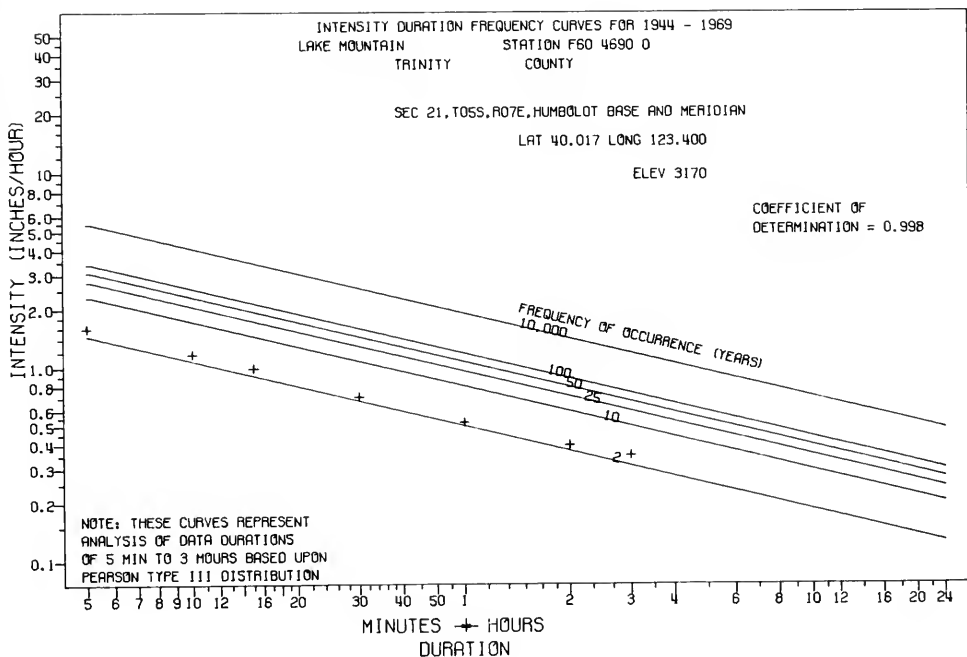
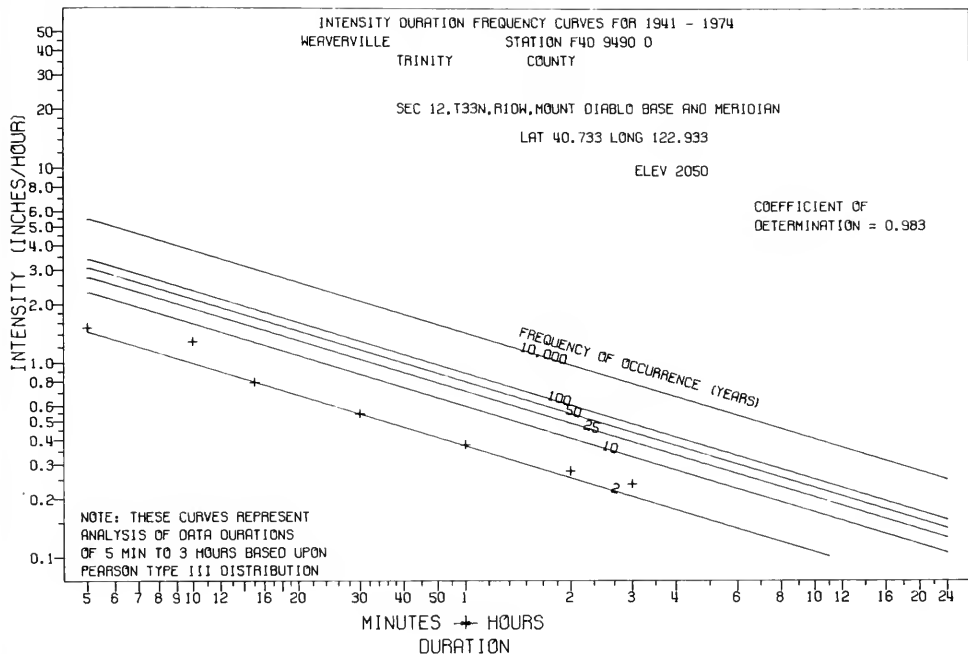


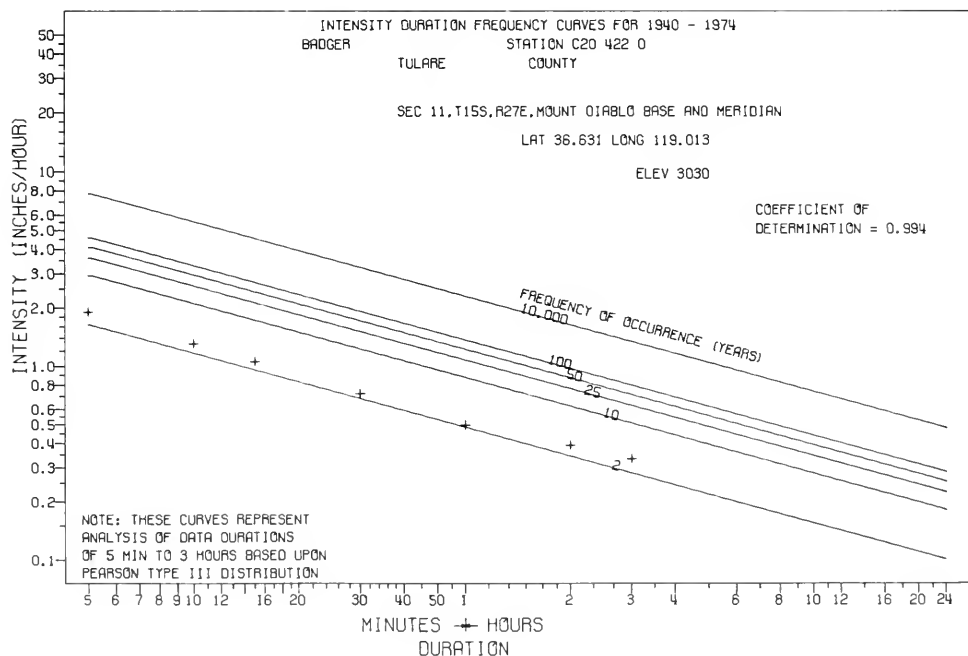
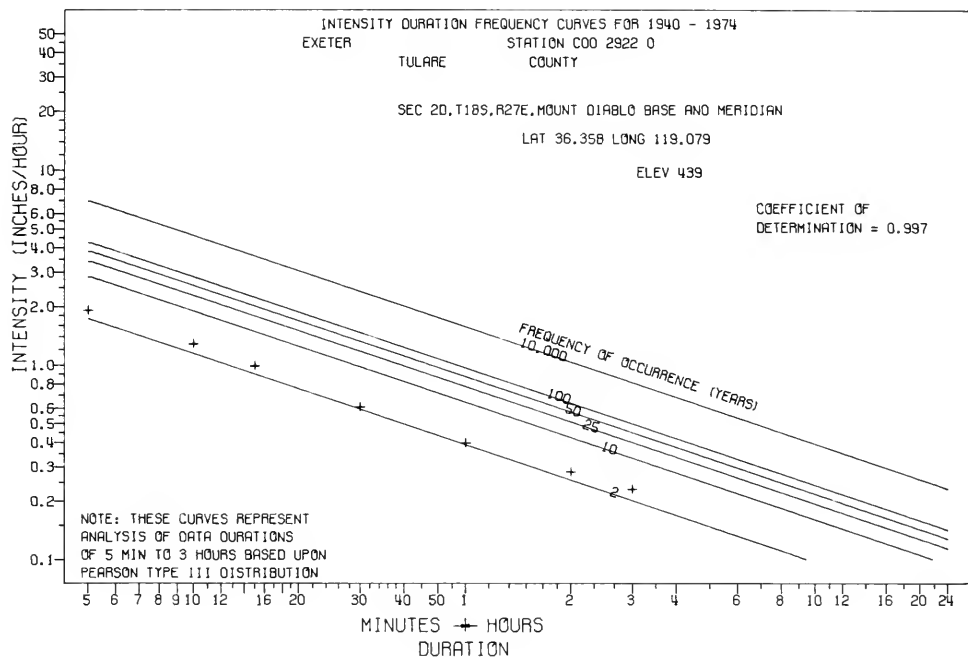


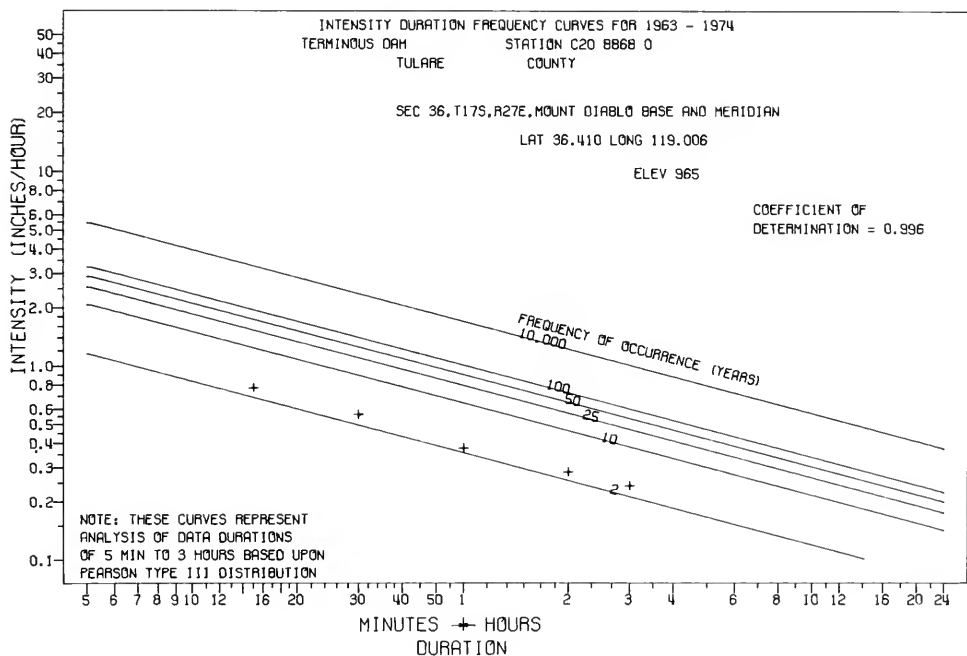
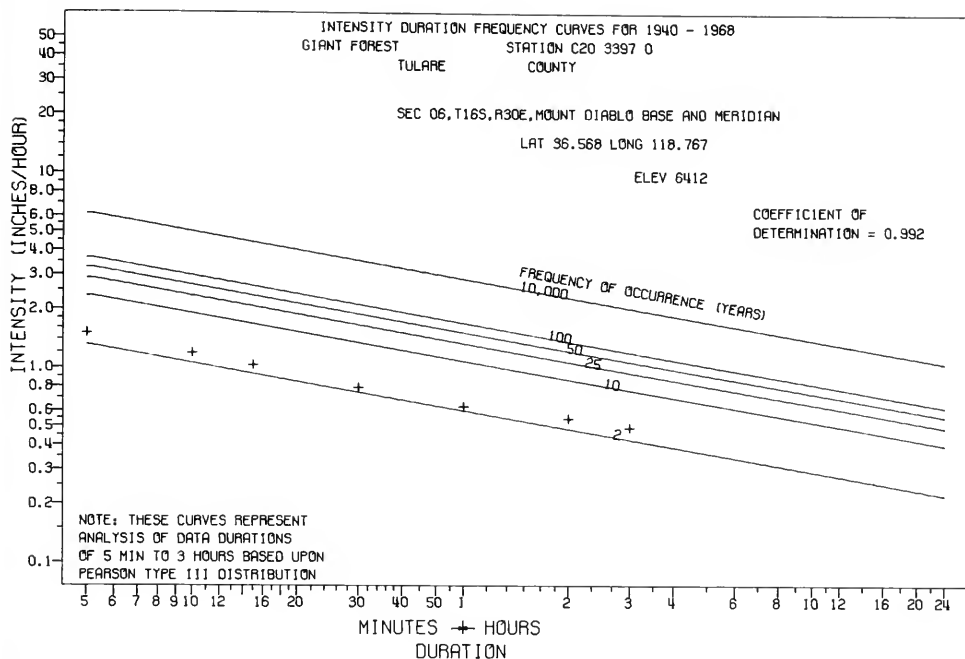


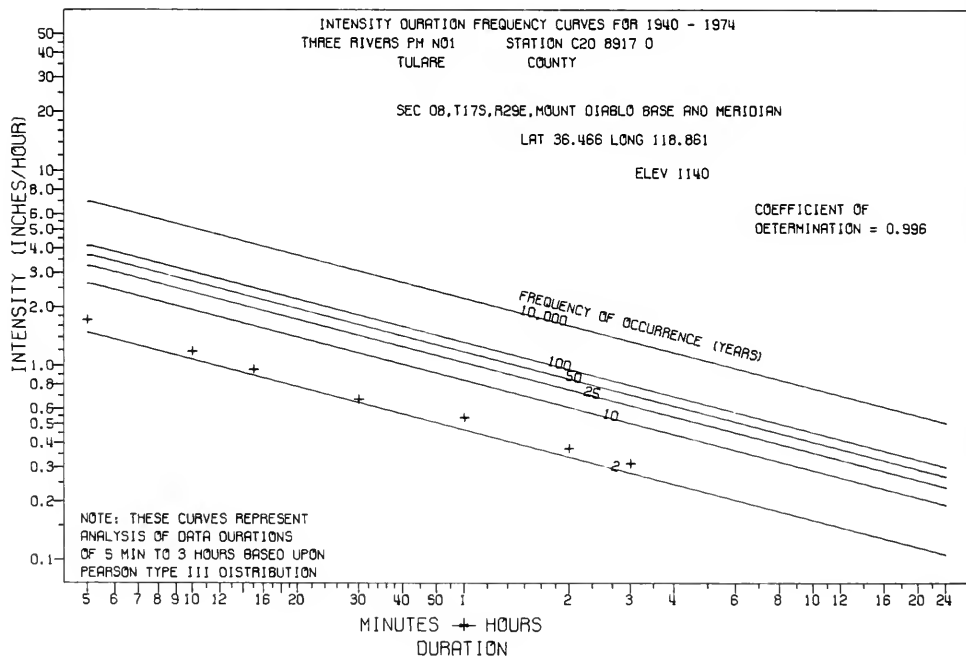
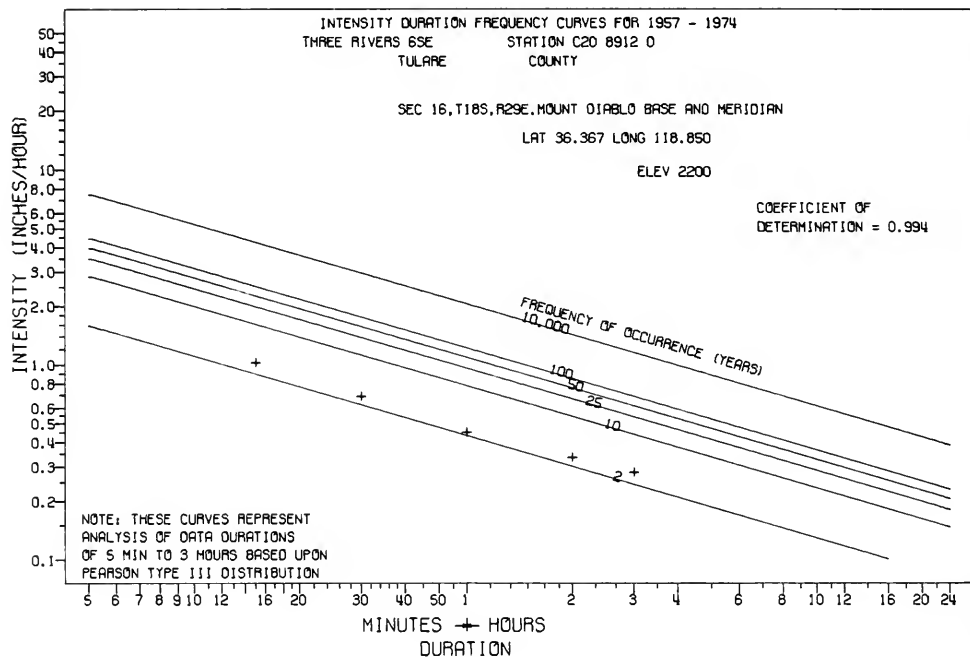


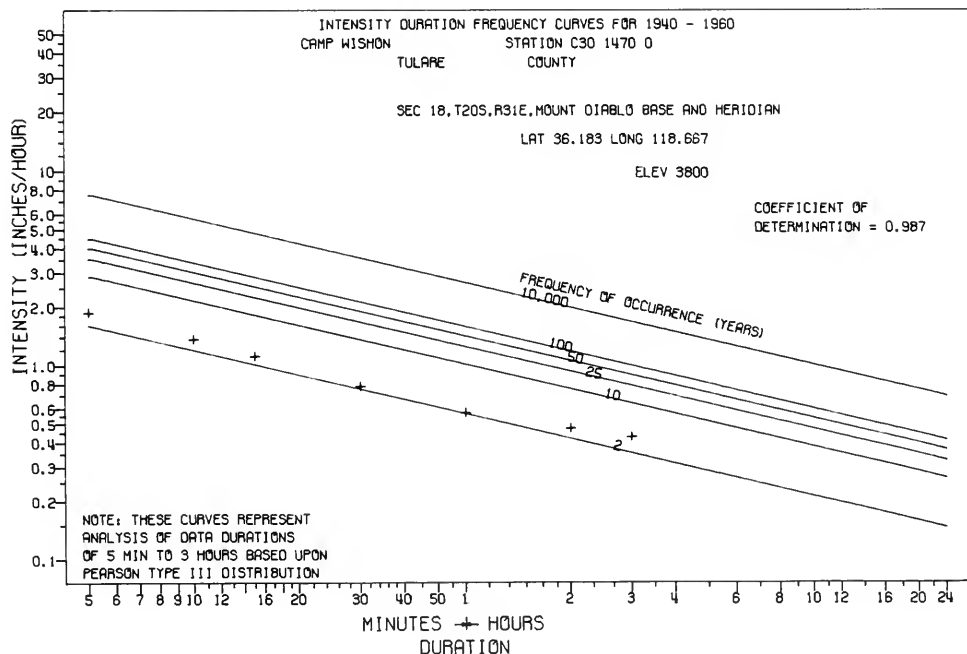
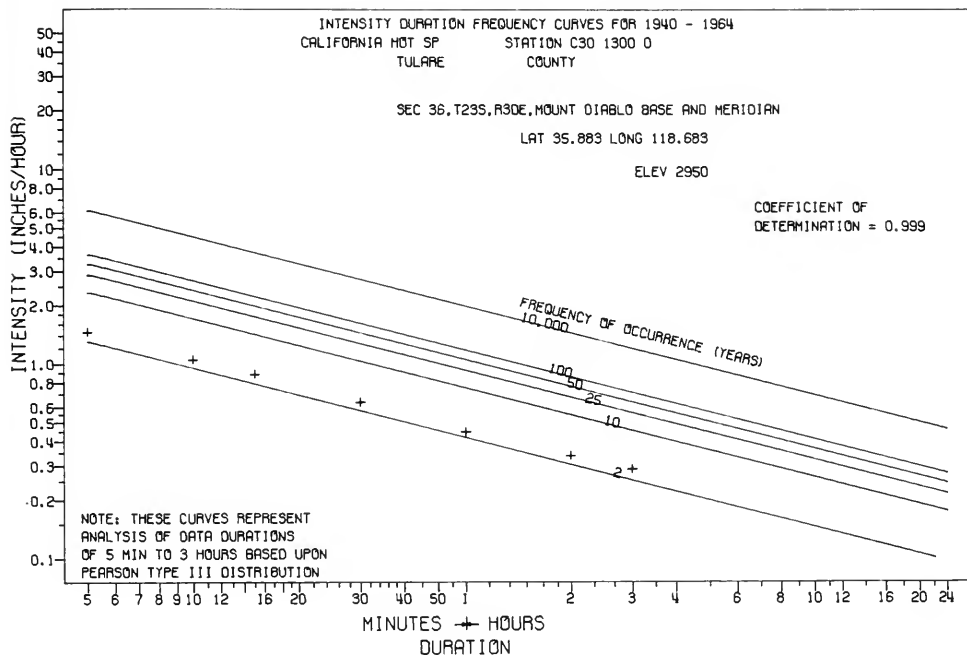


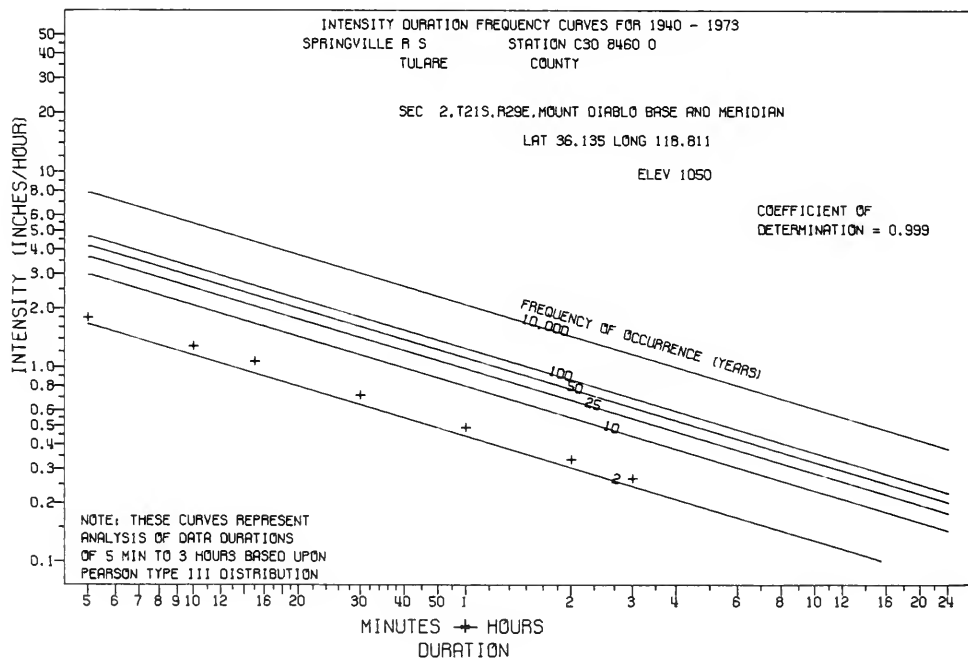
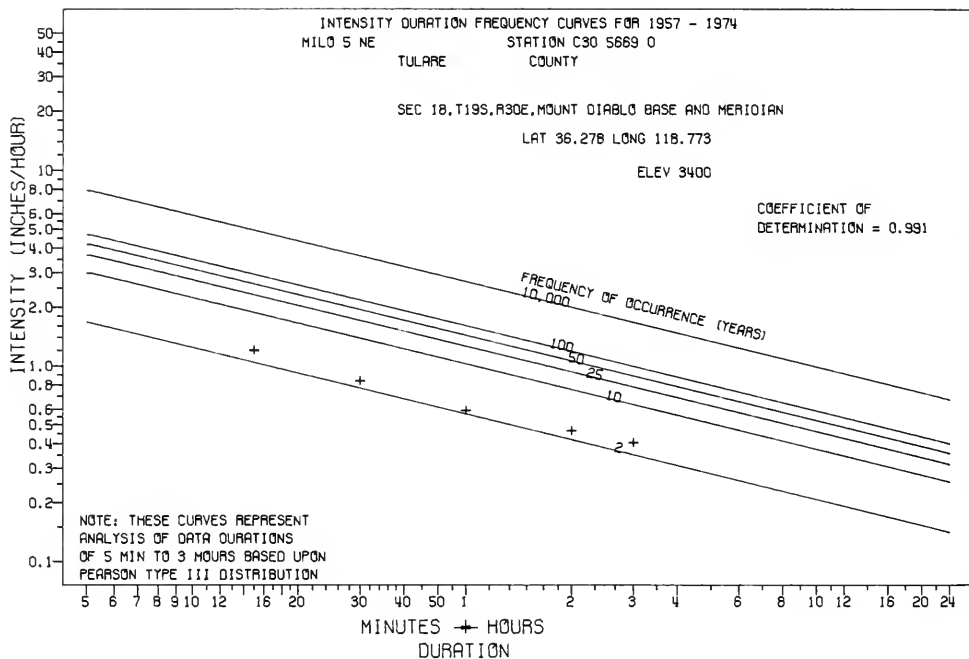


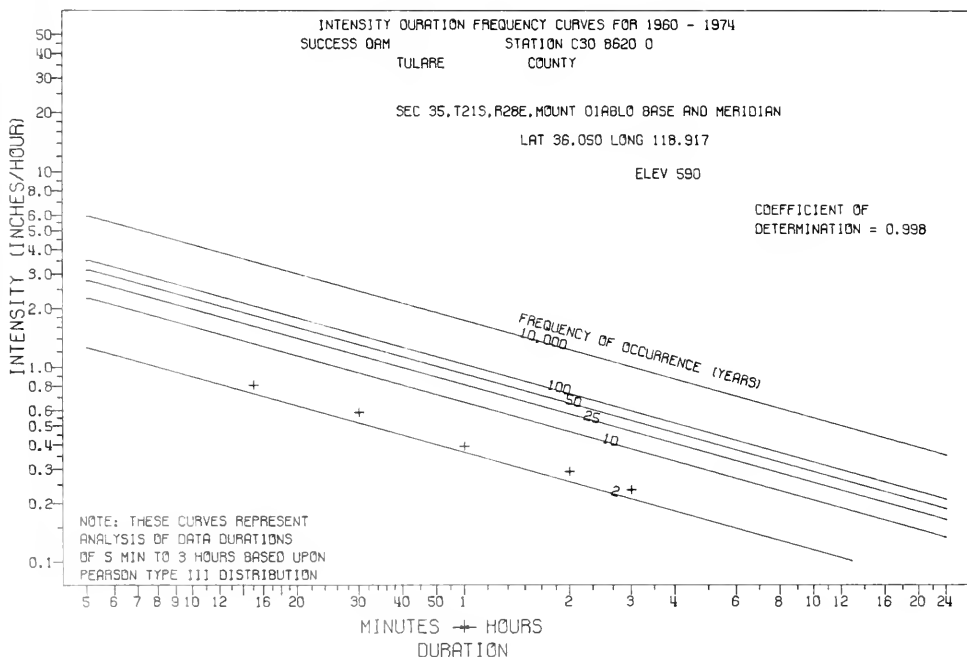
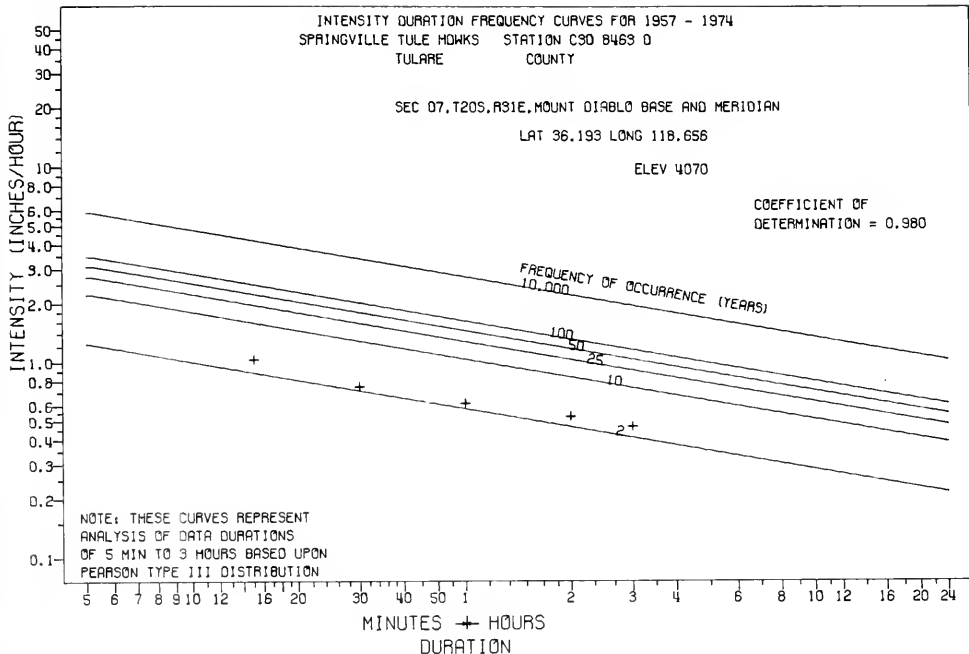


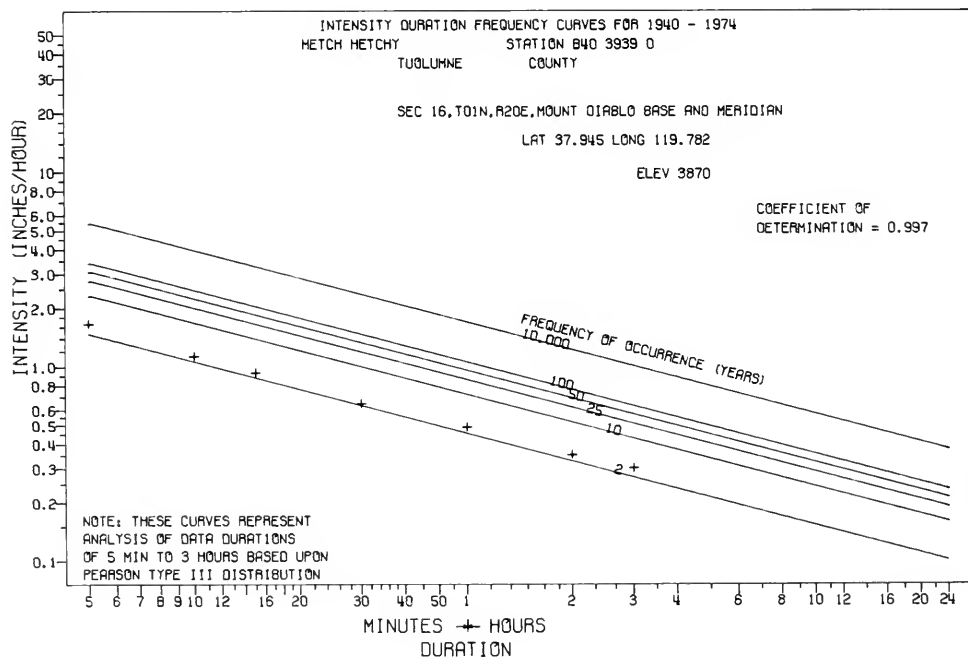
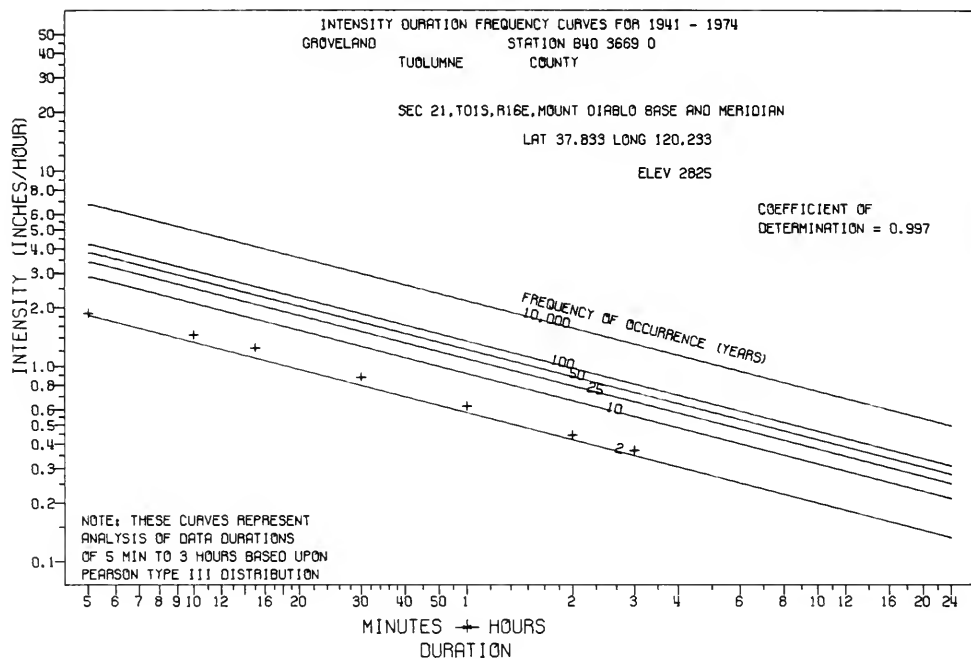


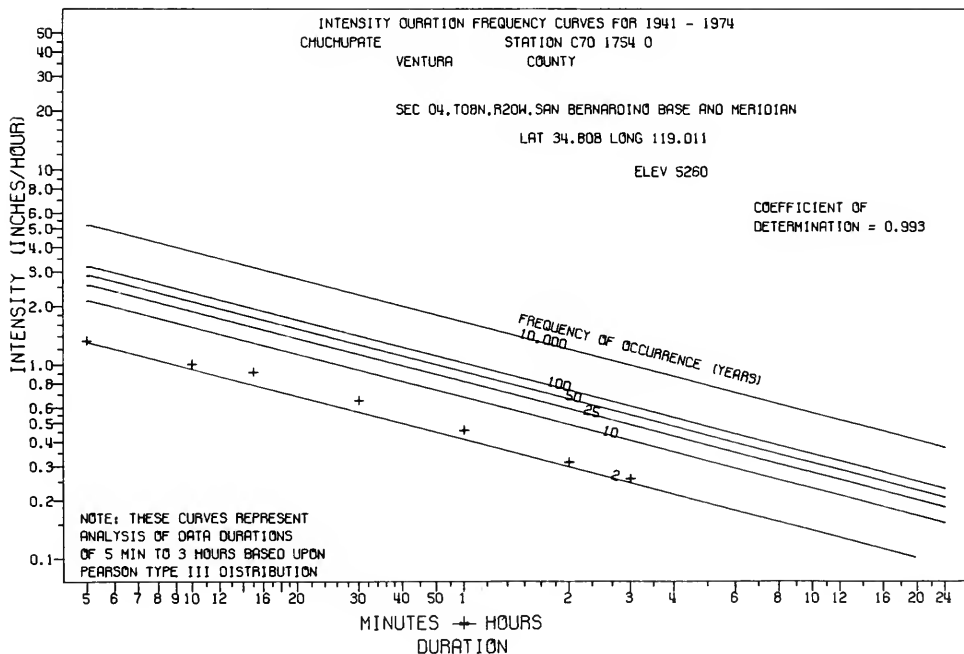
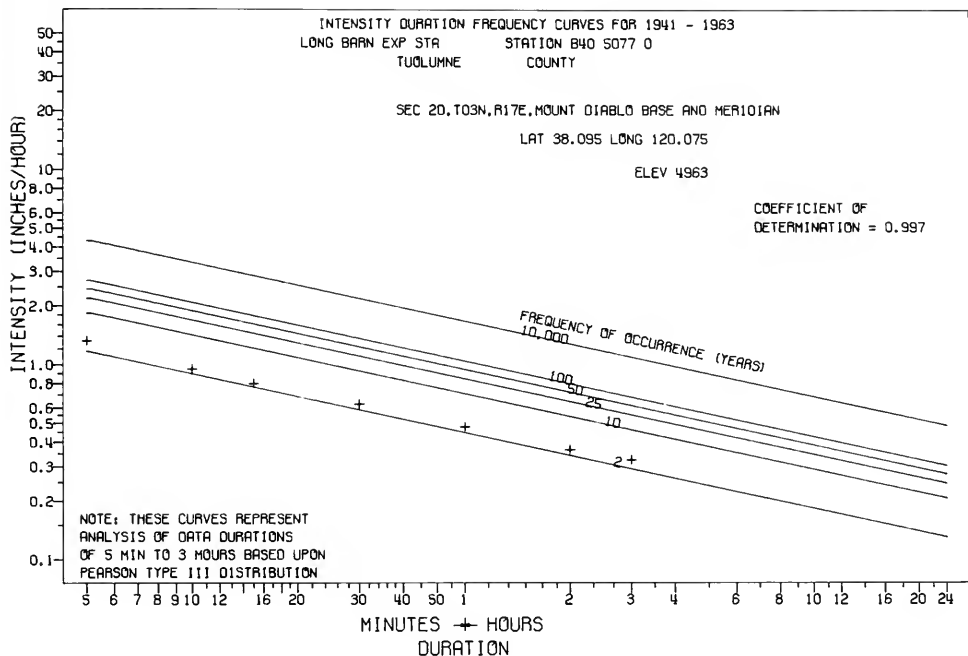


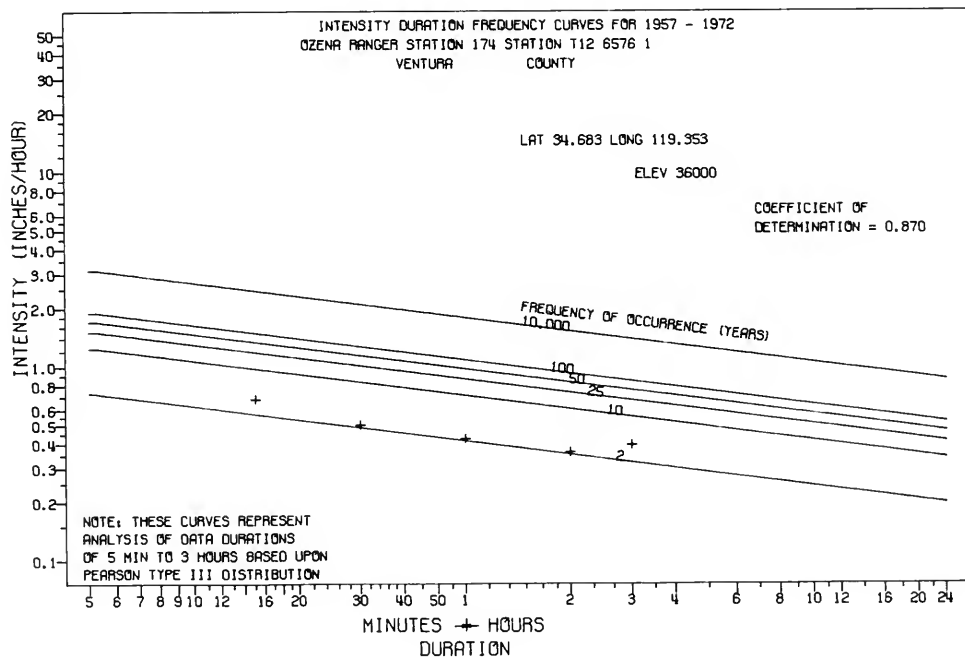
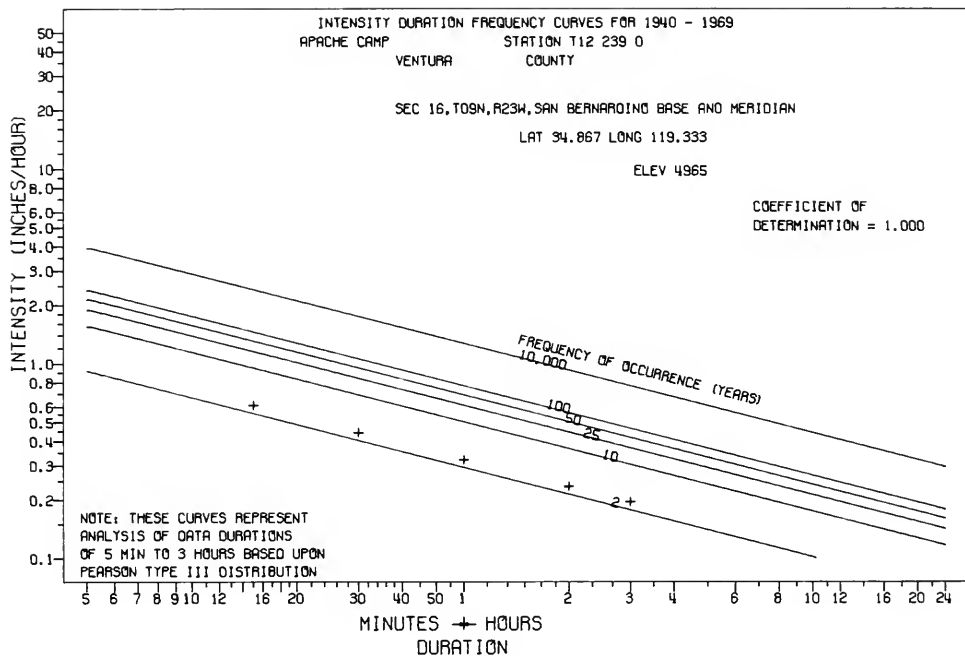


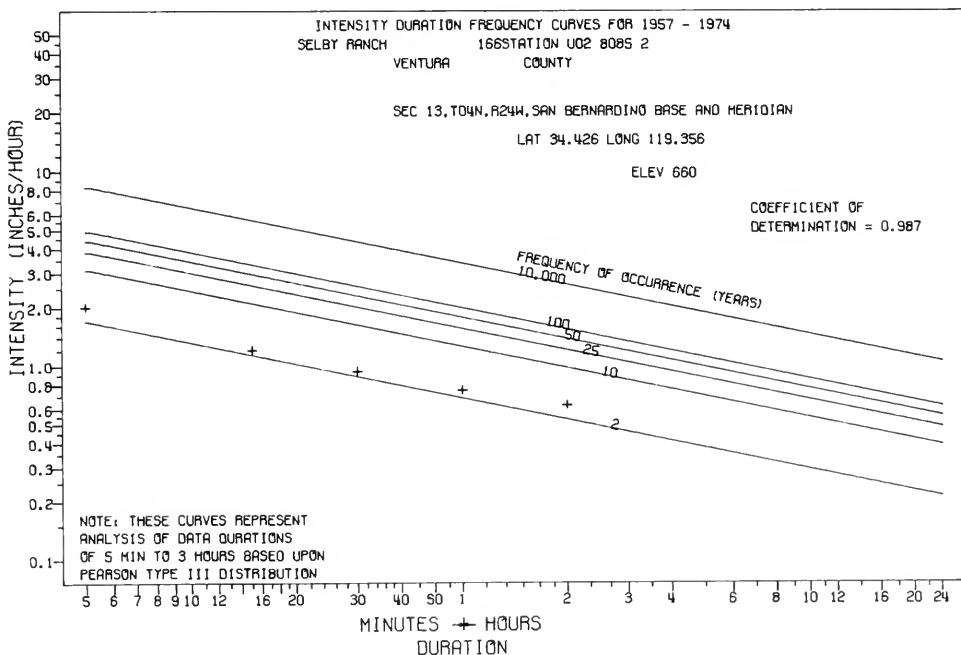
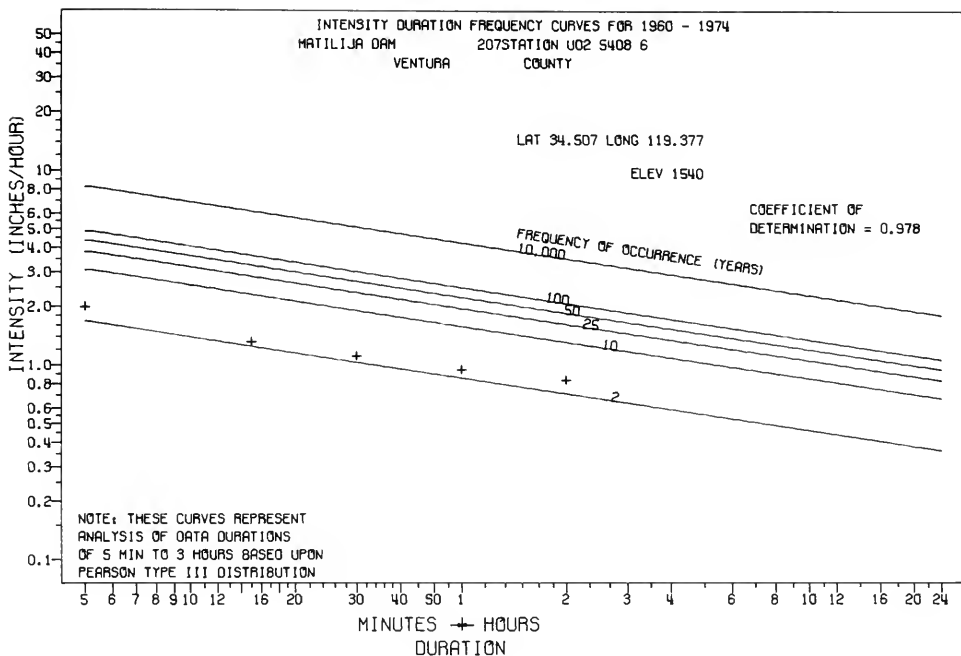


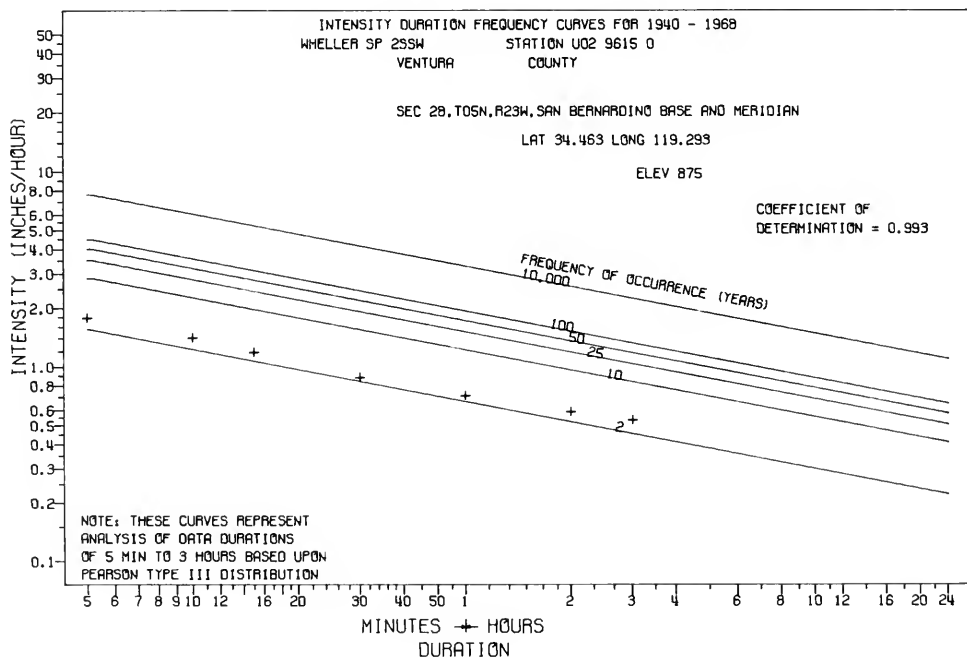
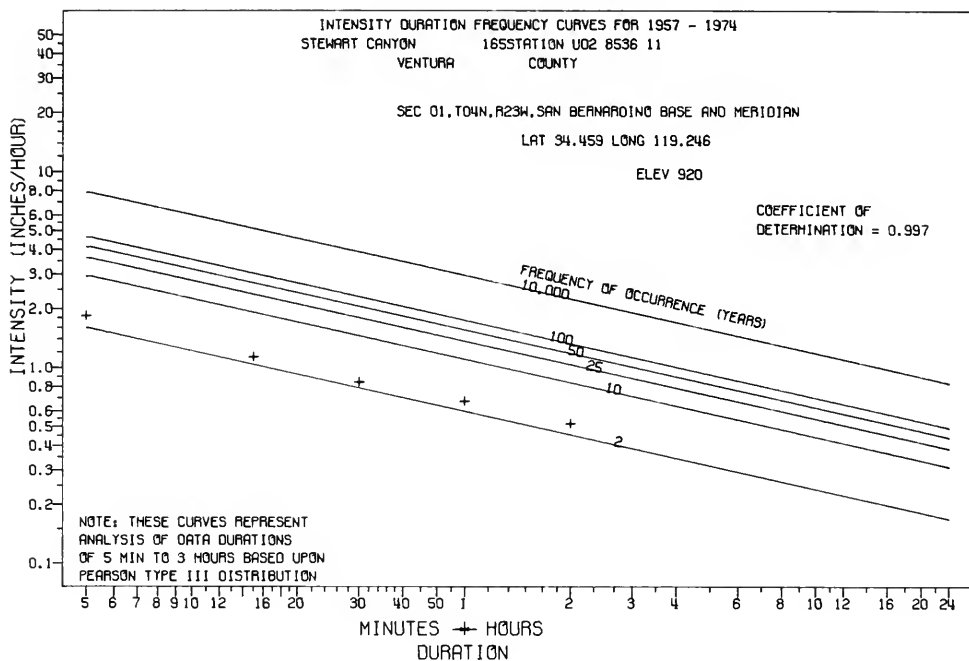










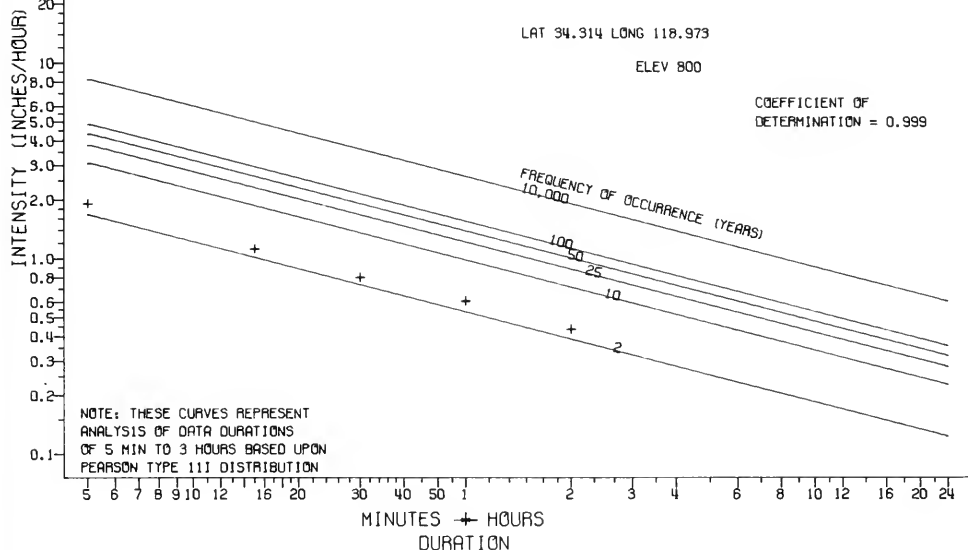


INTENSITY DURATION FREQUENCY CURVES FOR 1961 - 1974
BALCOM CANYON 206 STATION U03 450 18
VENTURA COUNTY

LAT 34.314 LONG 118.973

ELEV 800

COEFFICIENT OF
DETERMINATION = 0.999



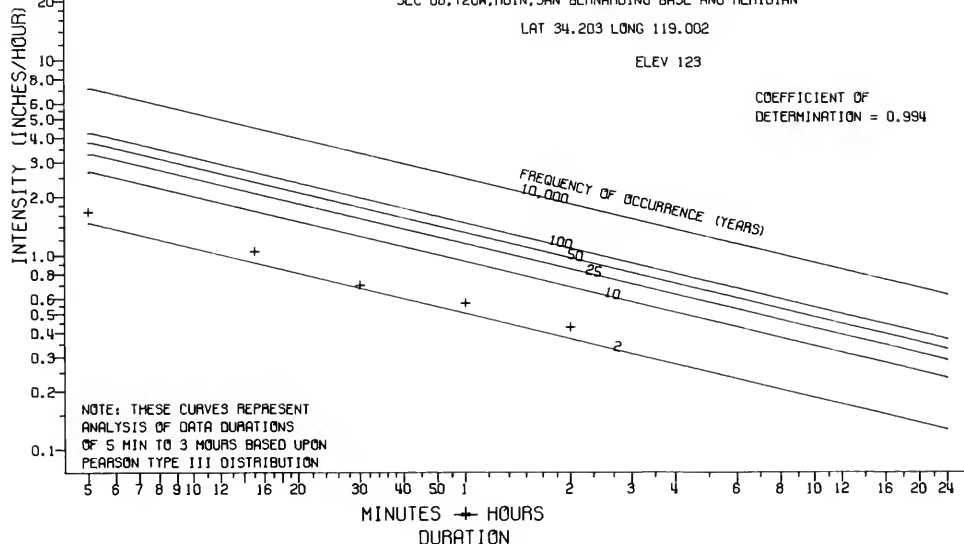
INTENSITY DURATION FREQUENCY CURVES FOR 1957 - 1974
CAMARILLO VC 194 STATION U03 1339 2
VENTURA COUNTY

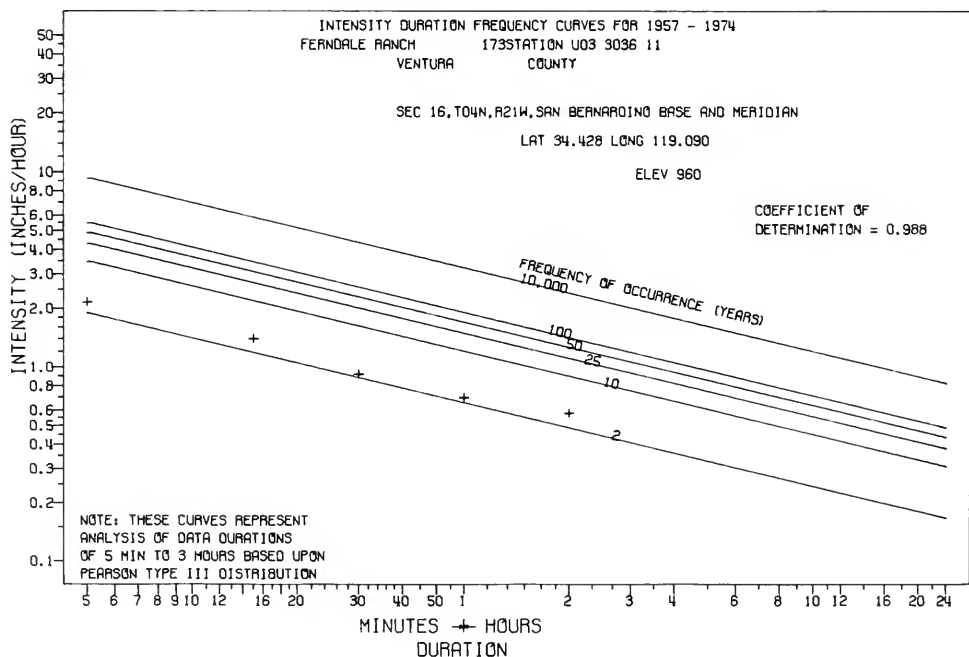
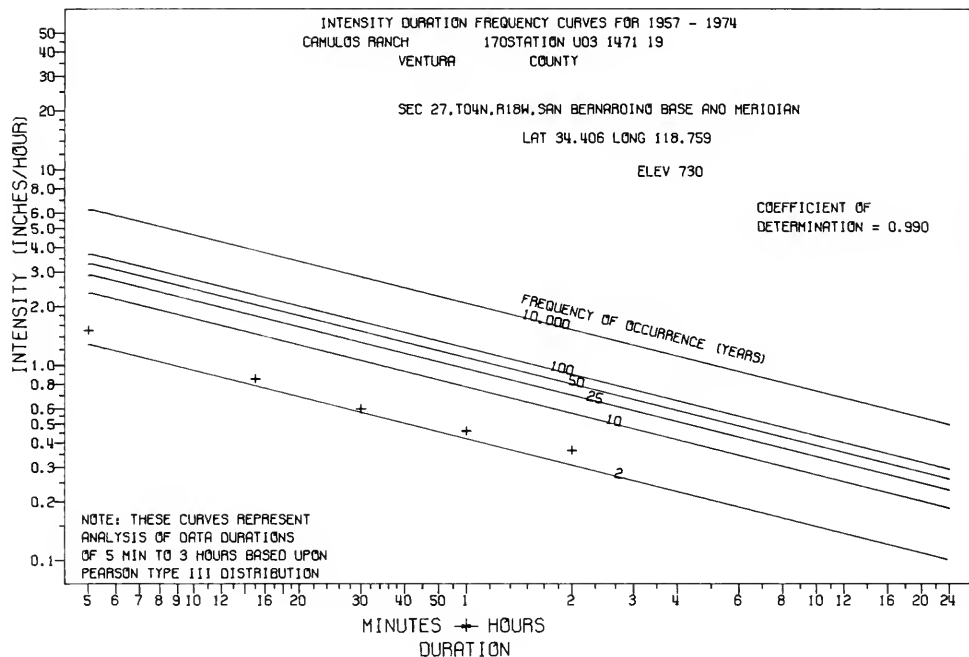
SEC 06, T20W, R01N, SAN BERNARDINO BASE AND MERIDIAN

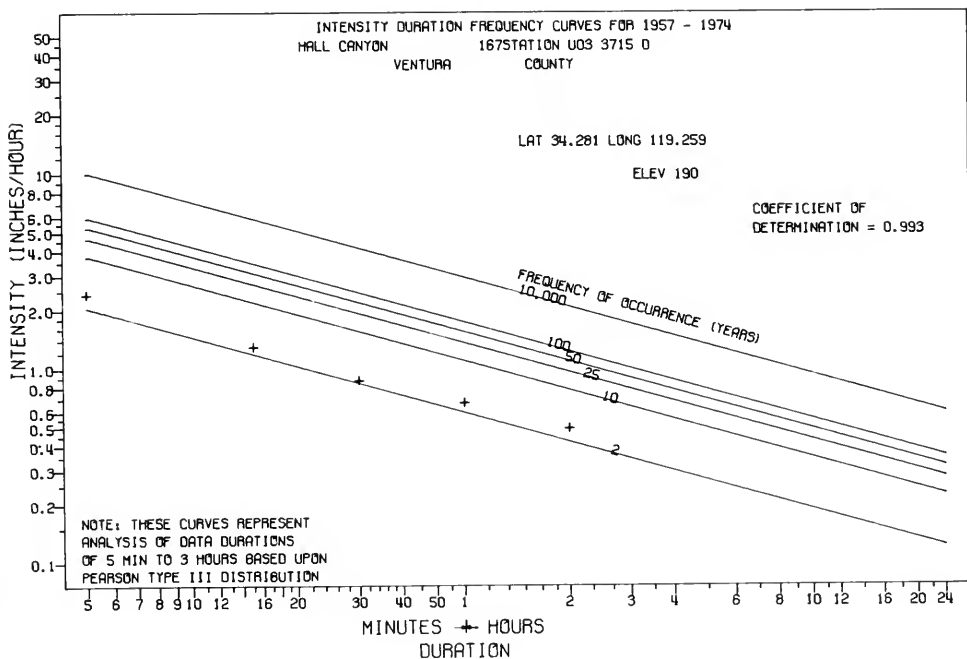
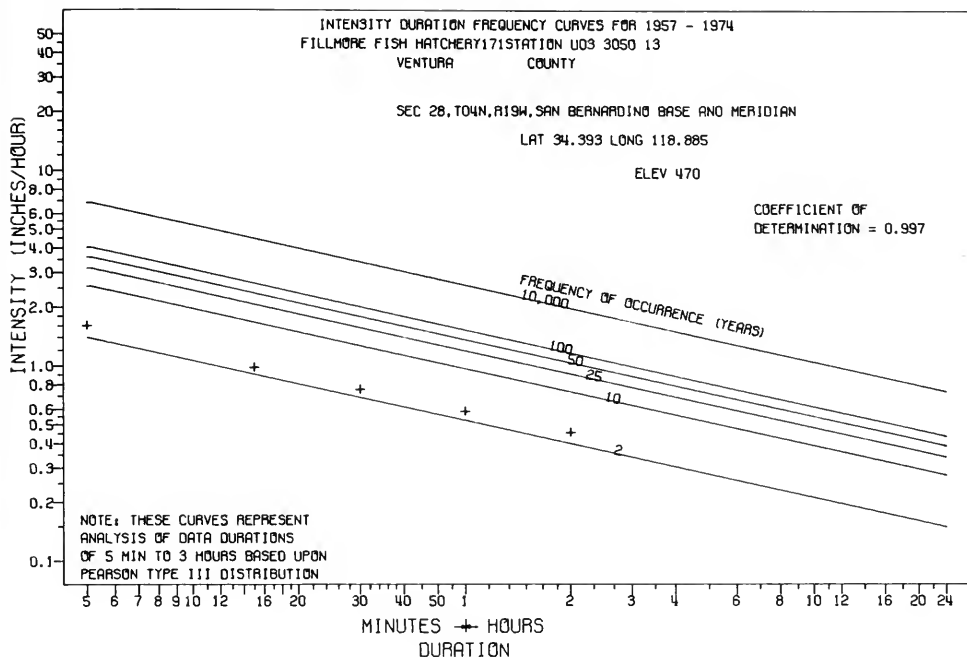
LAT 34.203 LONG 119.002

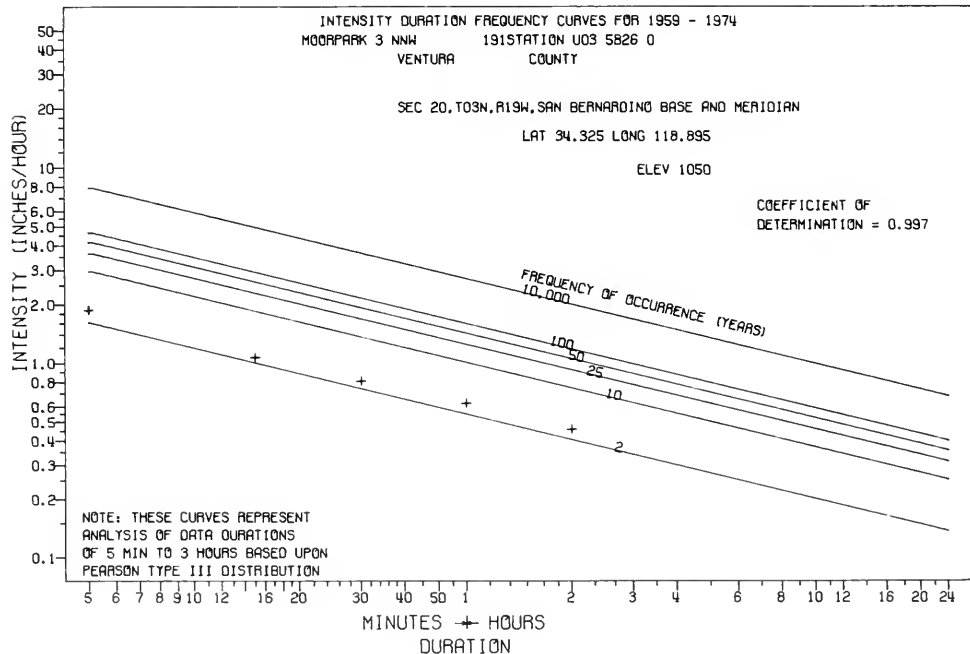
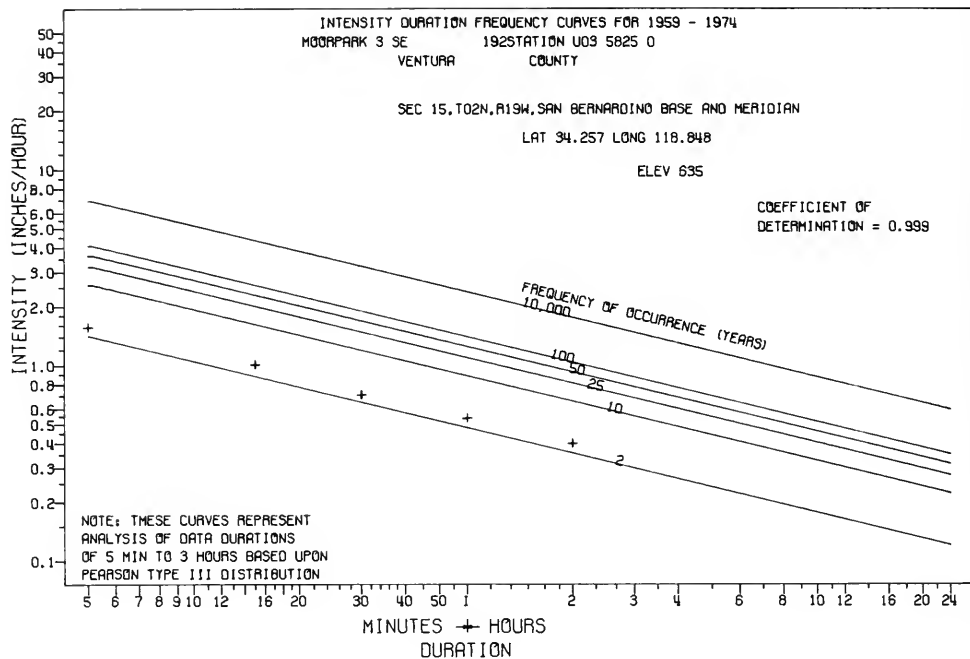
ELEV 123

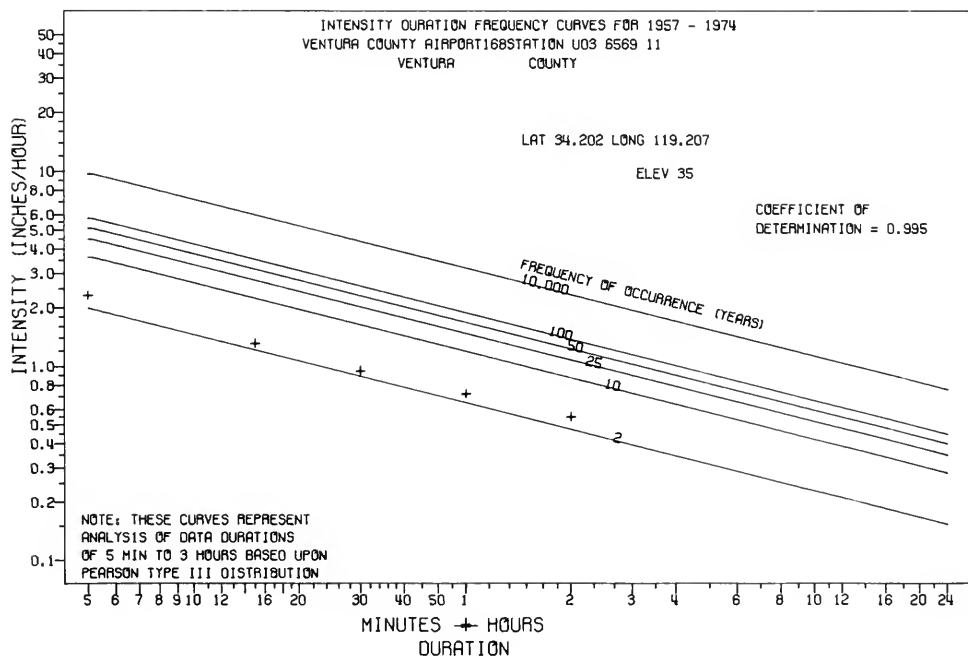
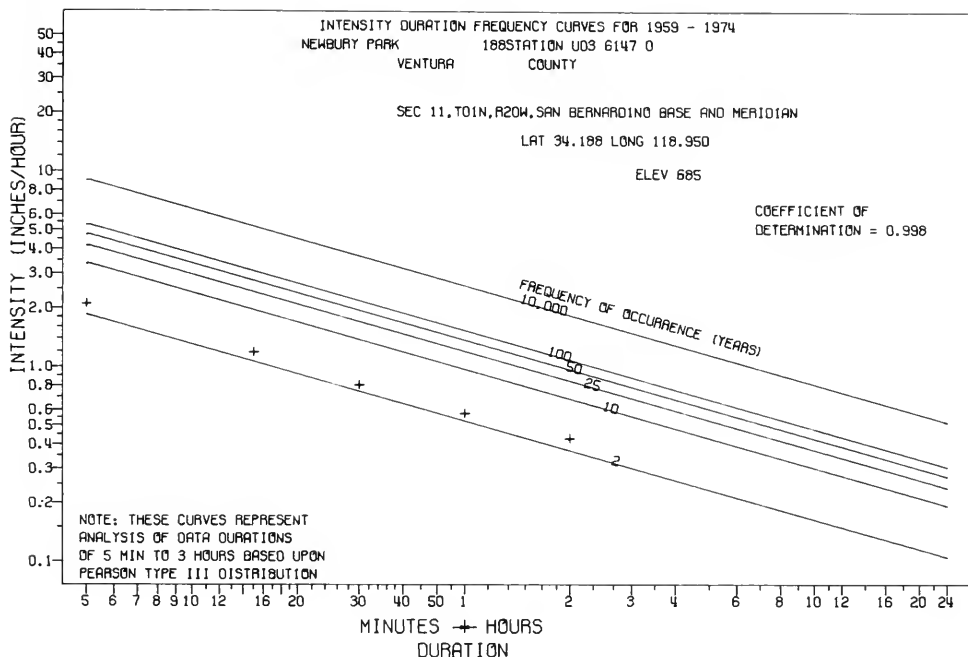
COEFFICIENT OF
DETERMINATION = 0.994

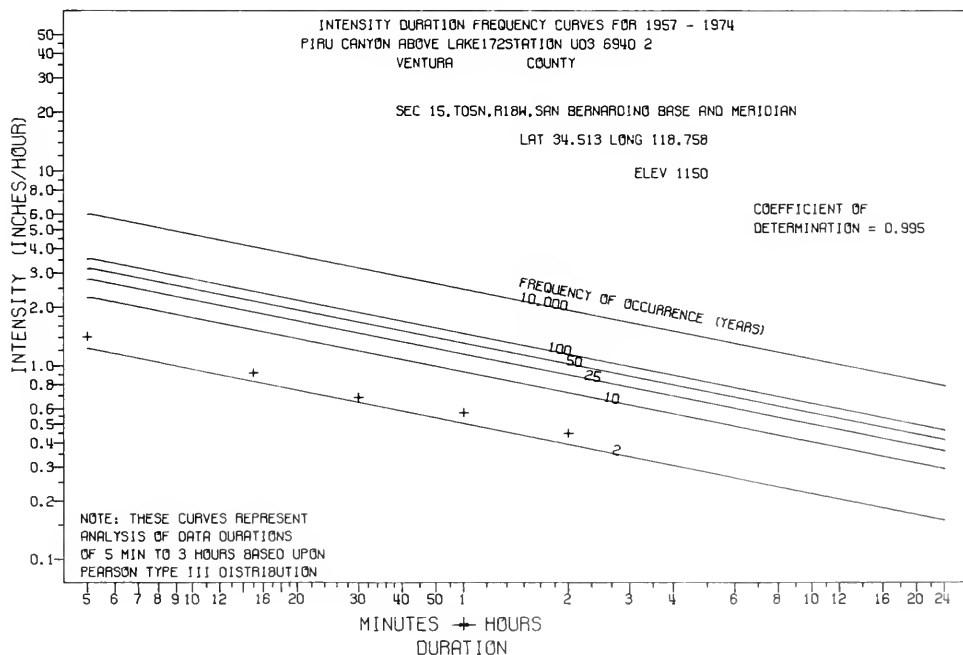
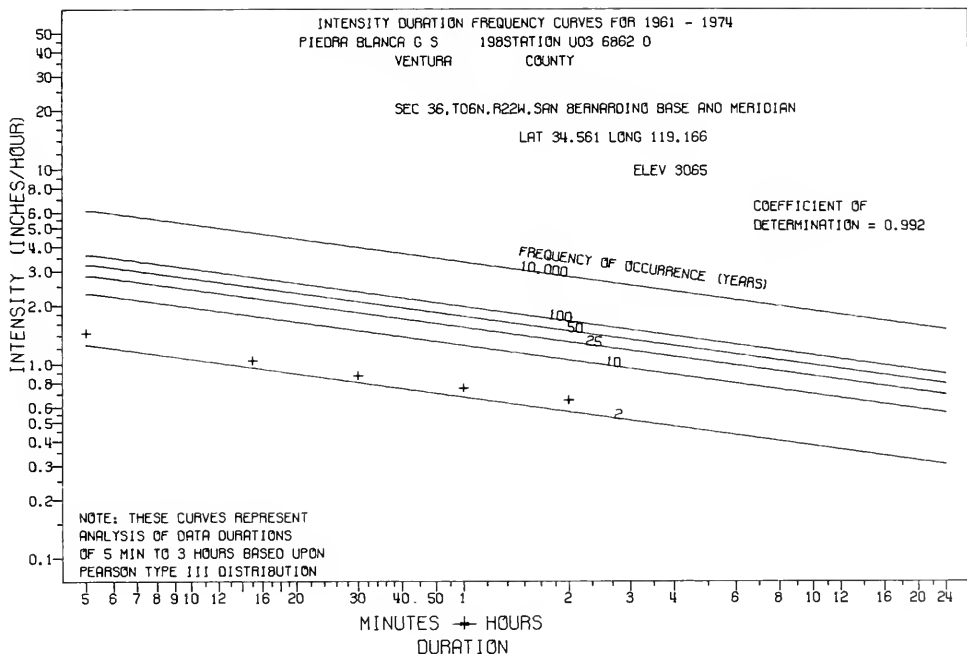


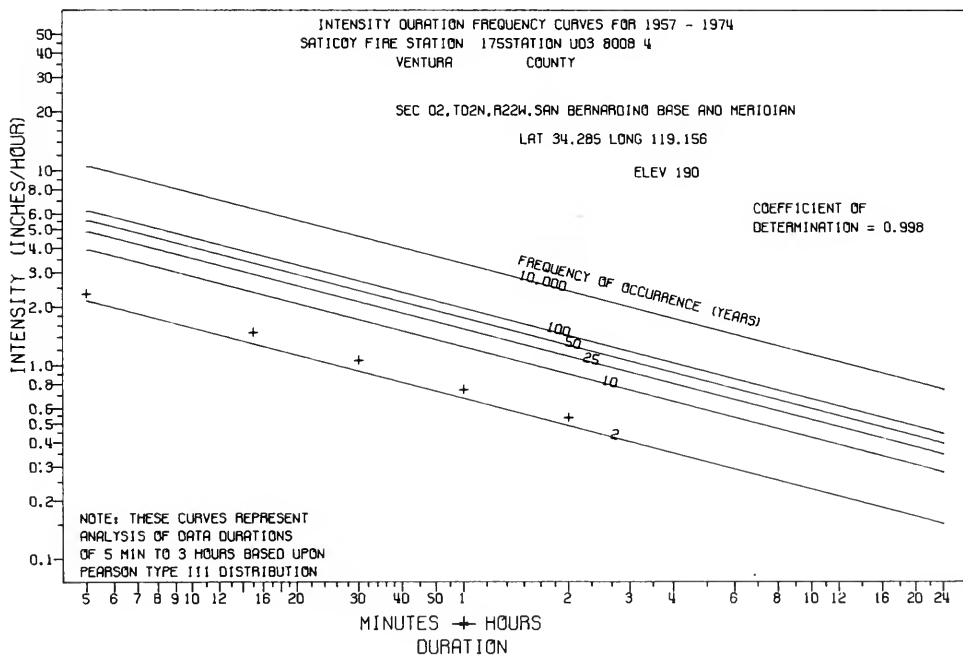
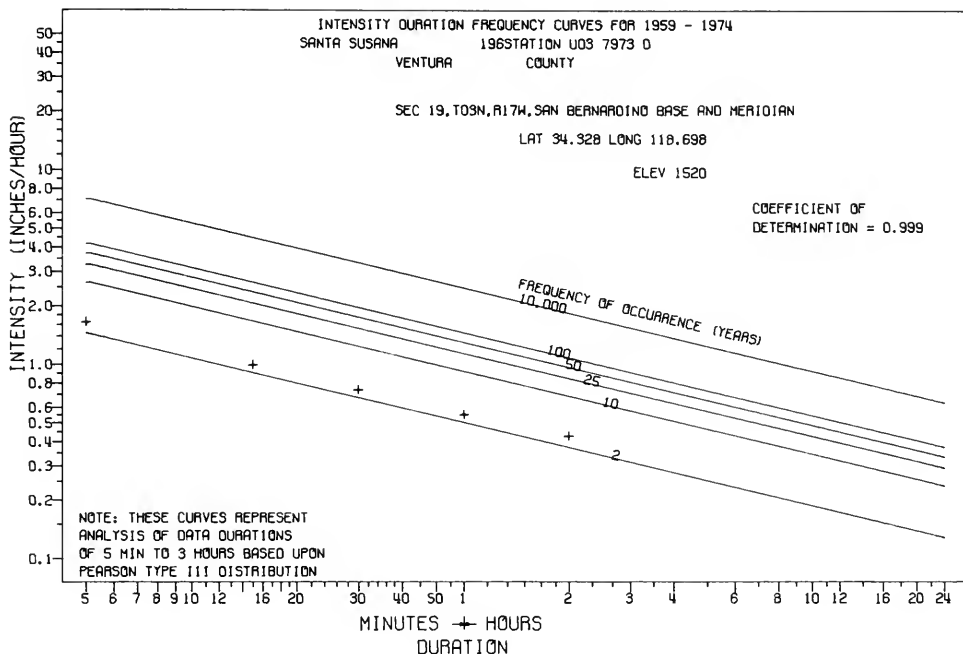


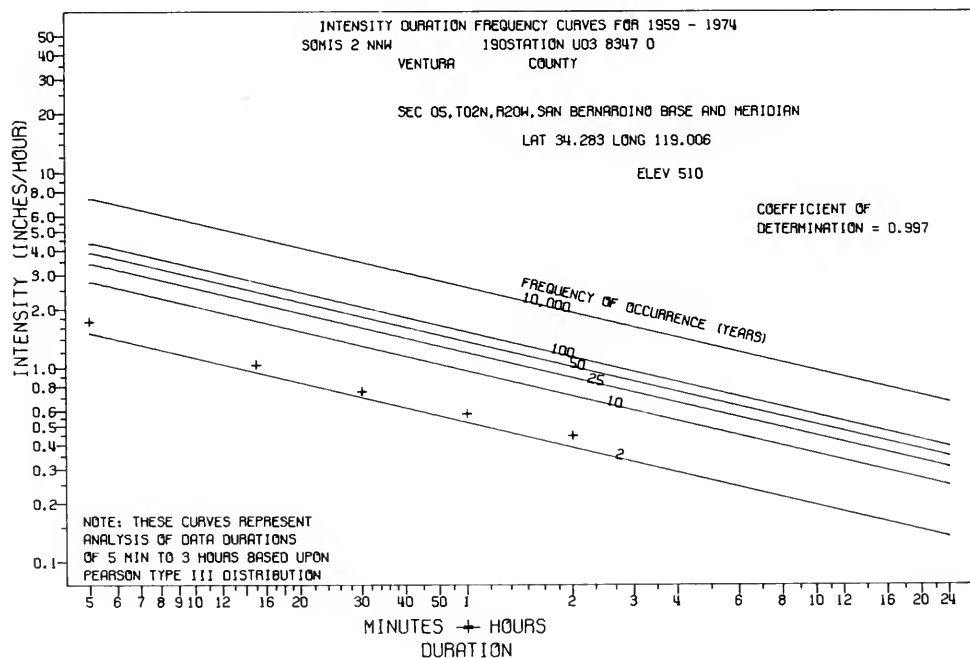
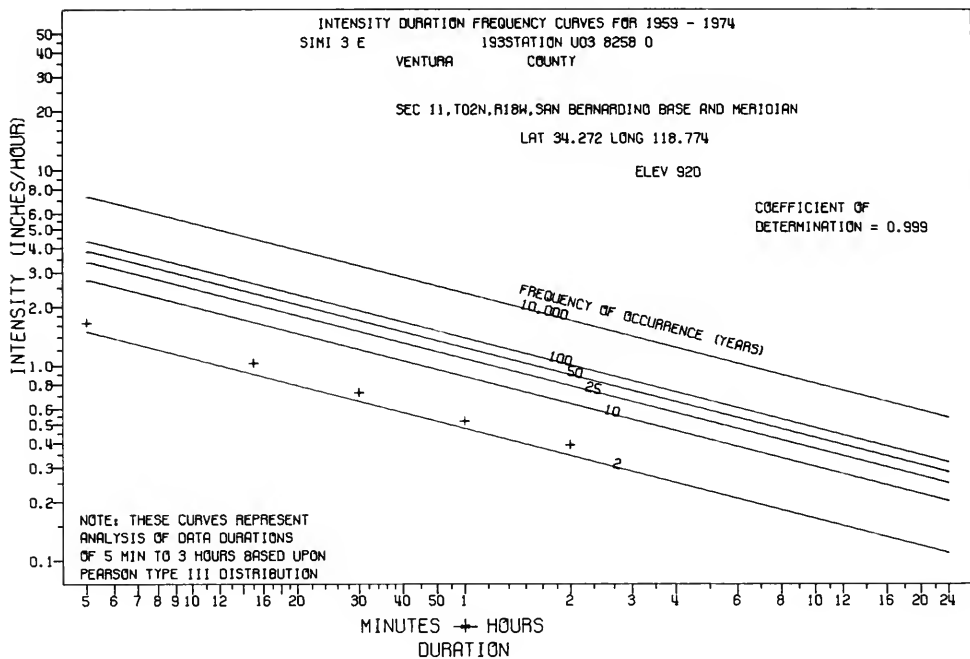


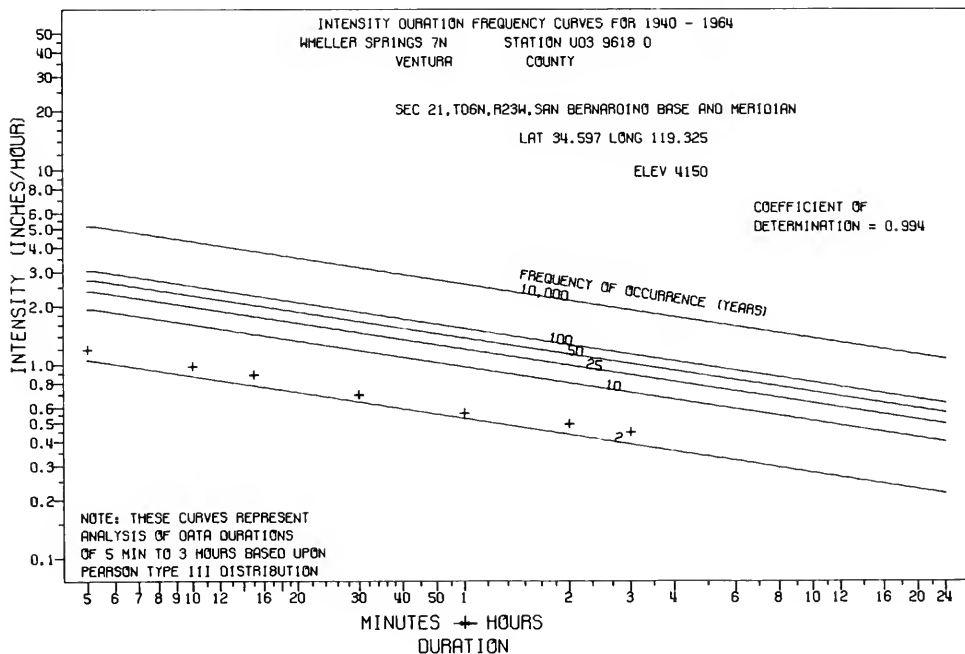
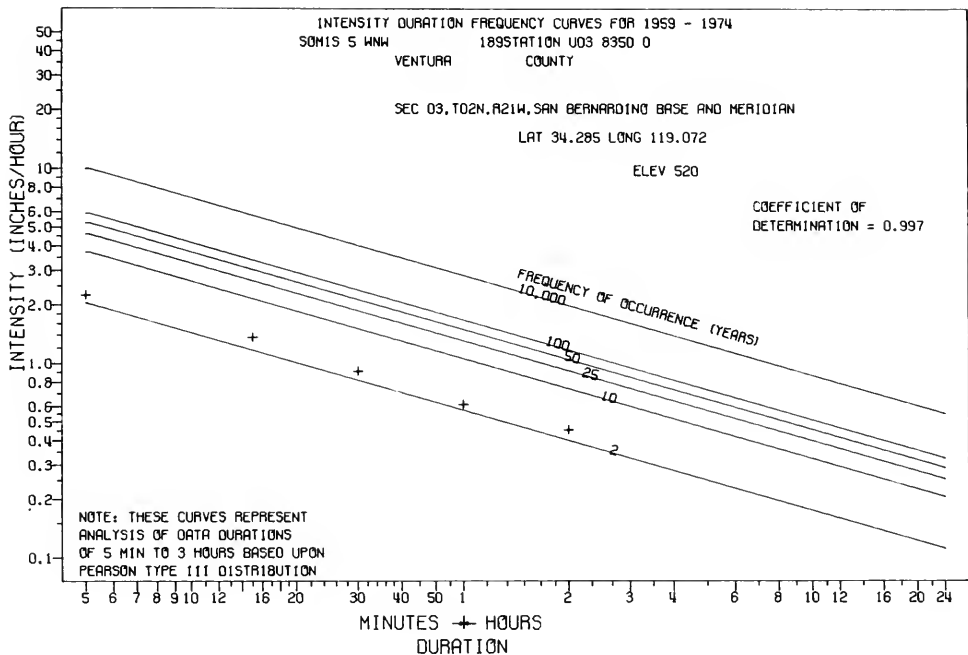


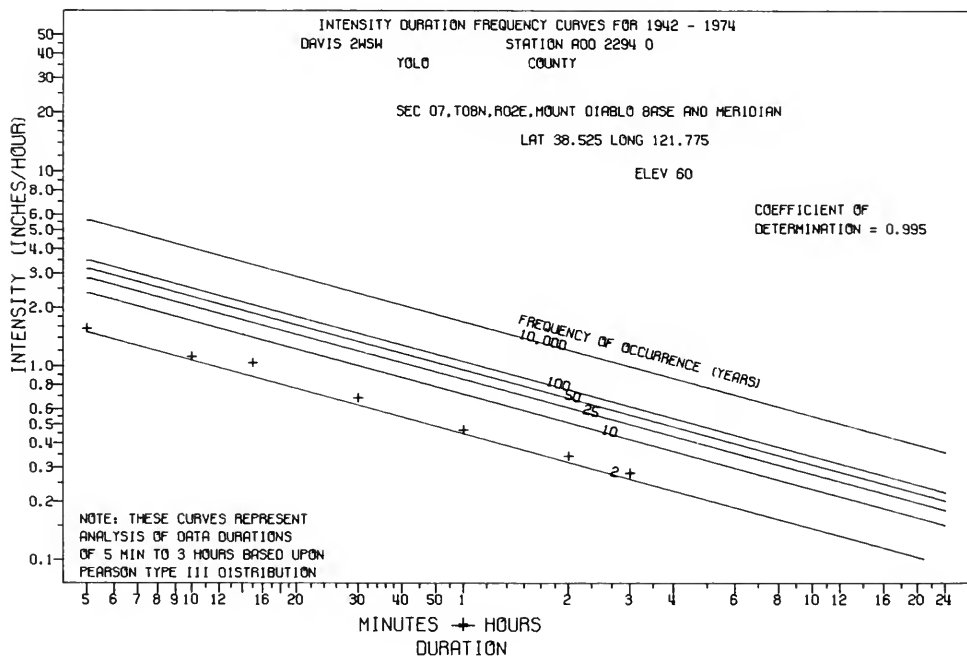
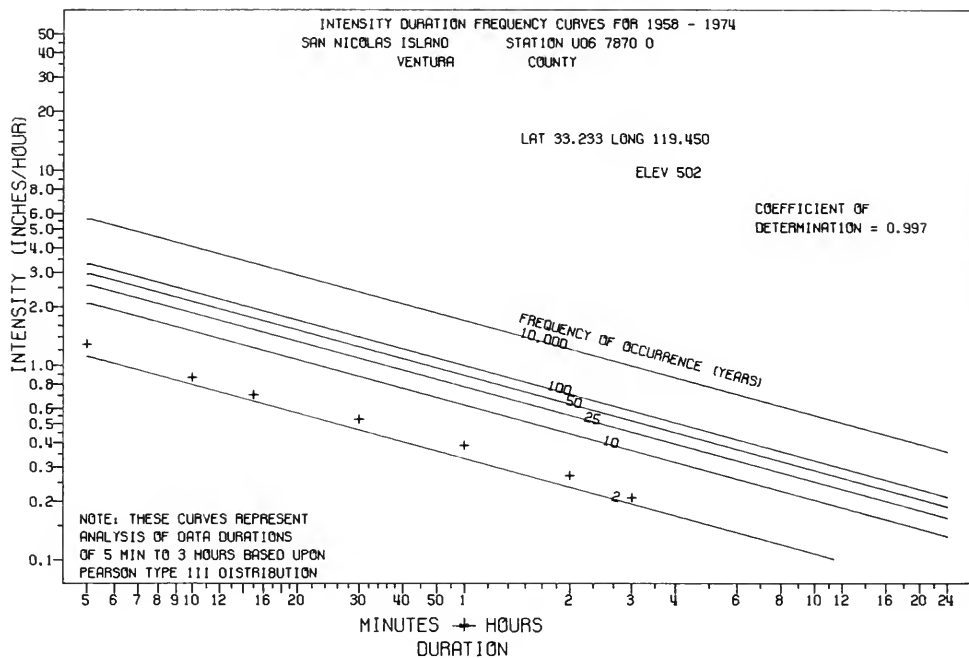


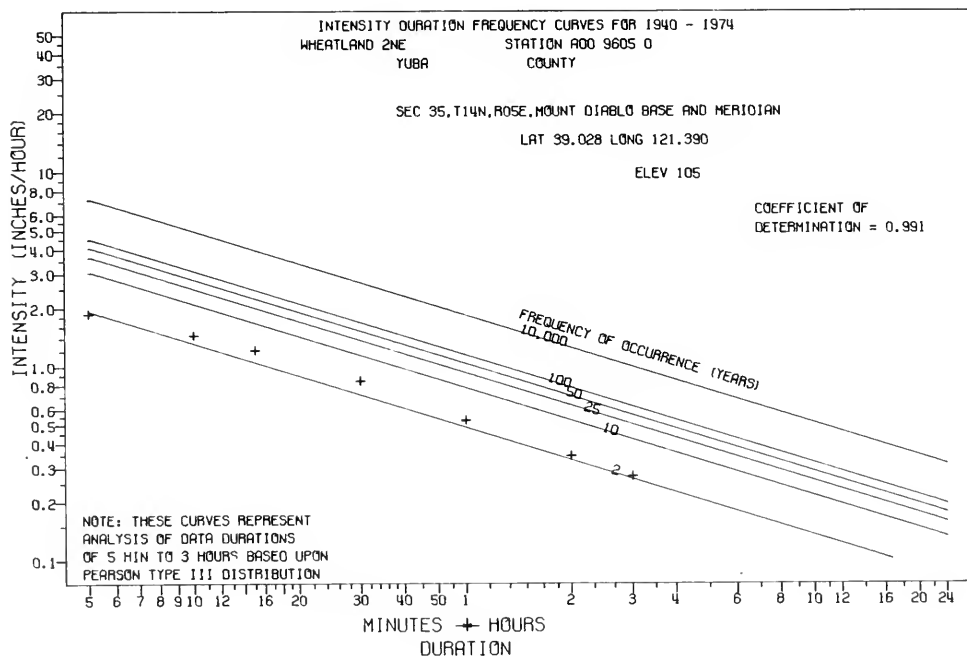
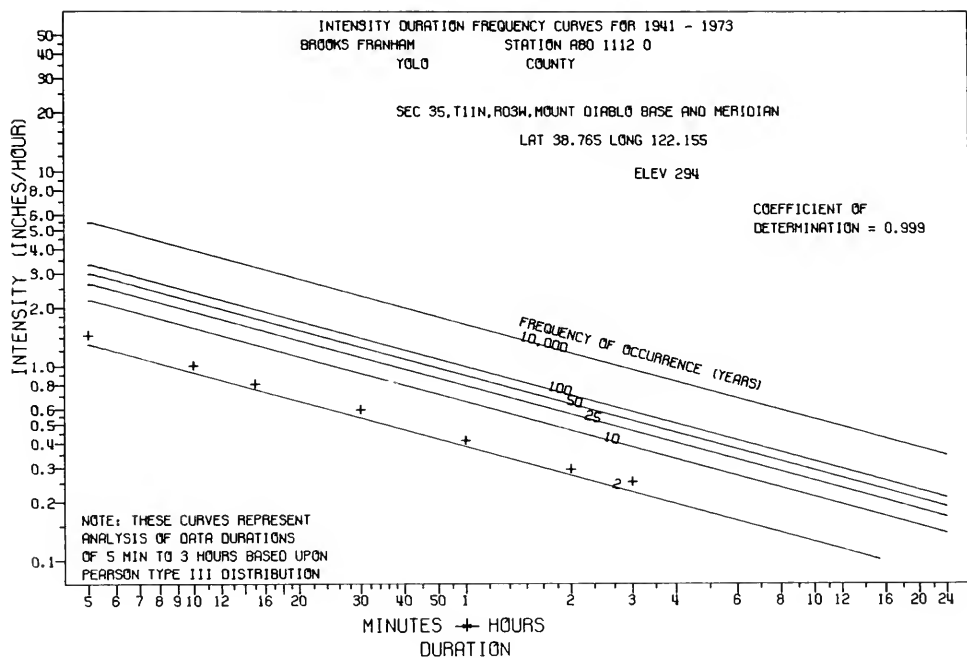


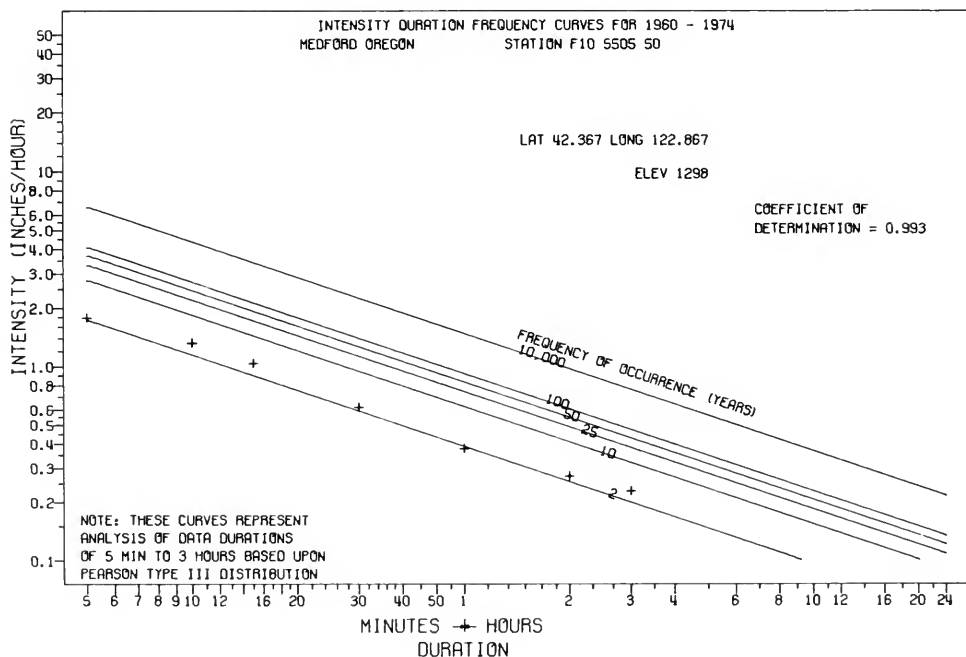
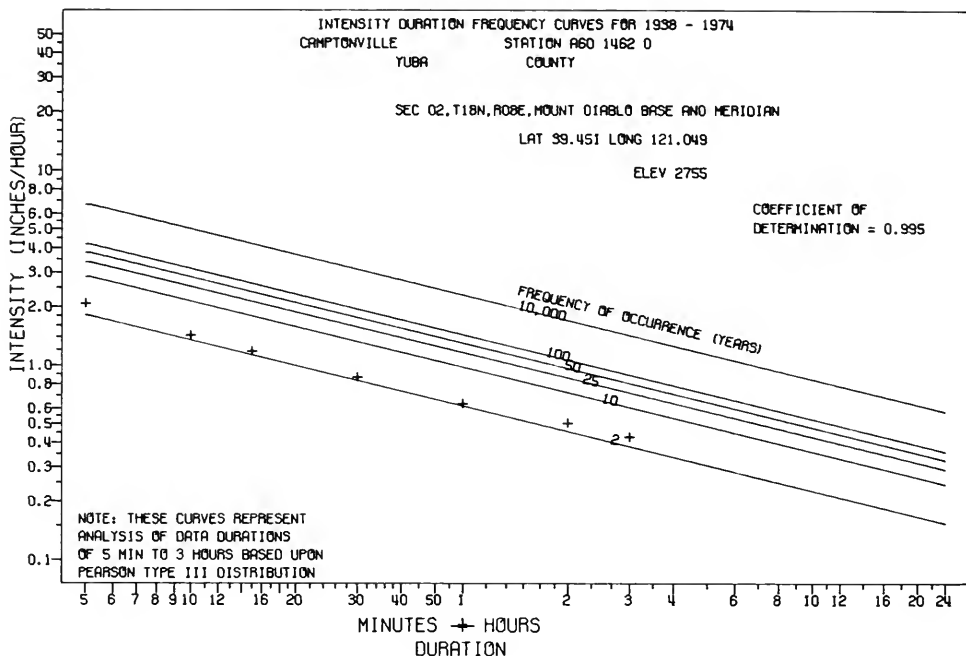


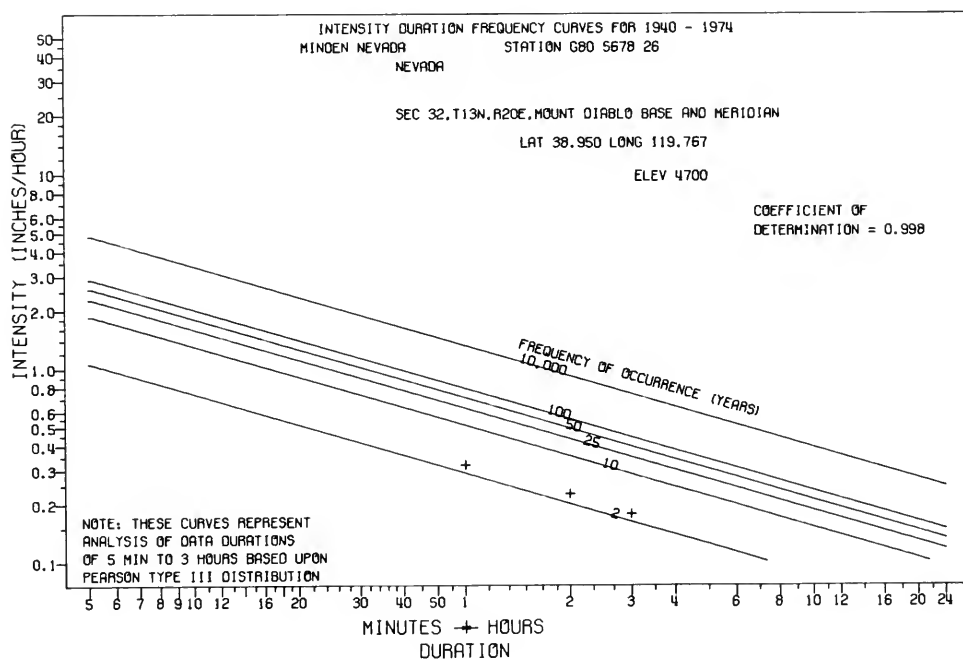
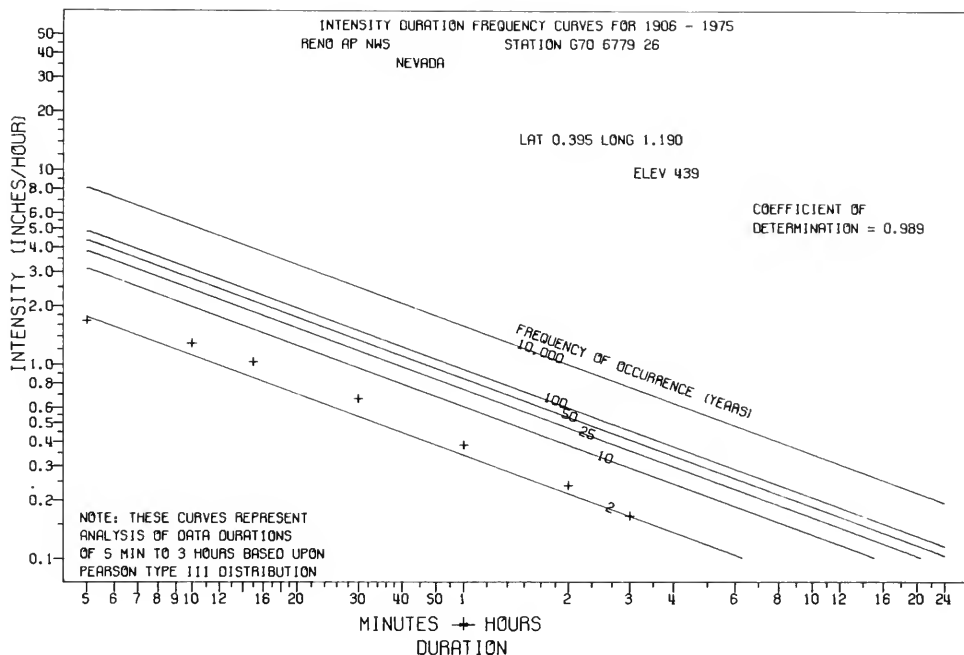


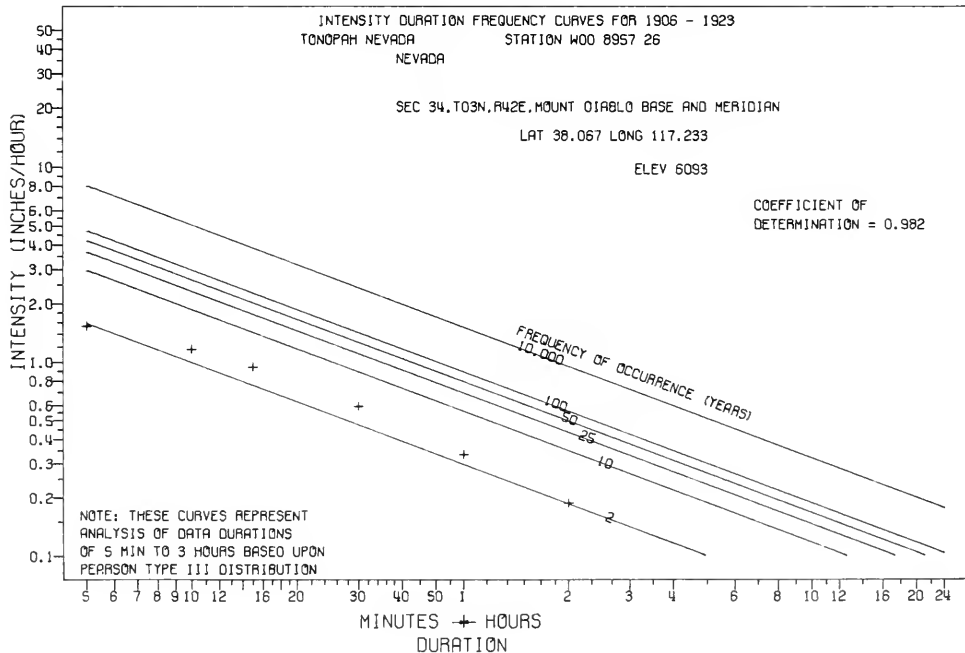
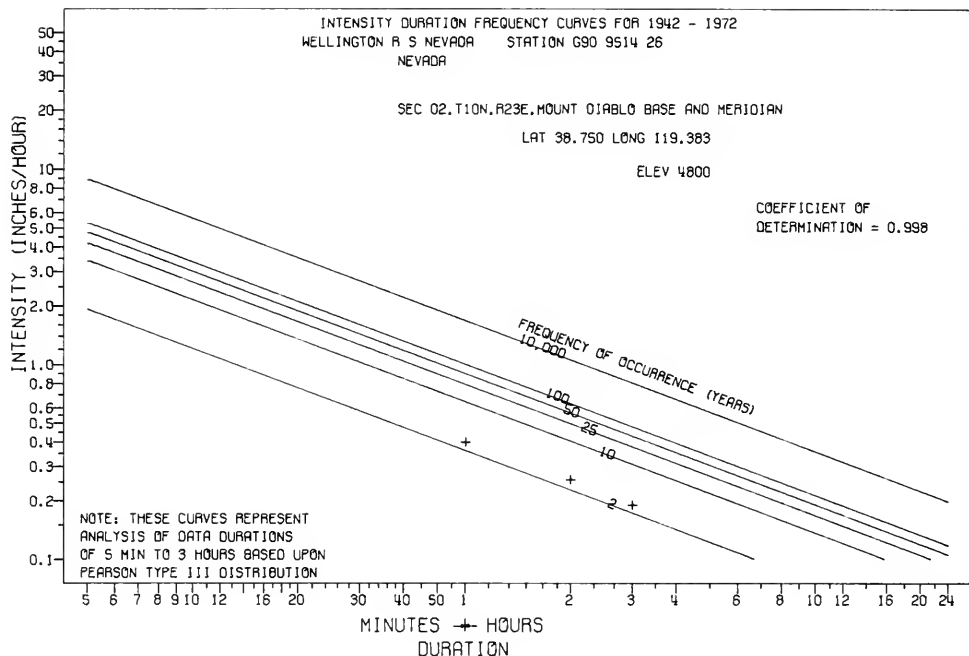


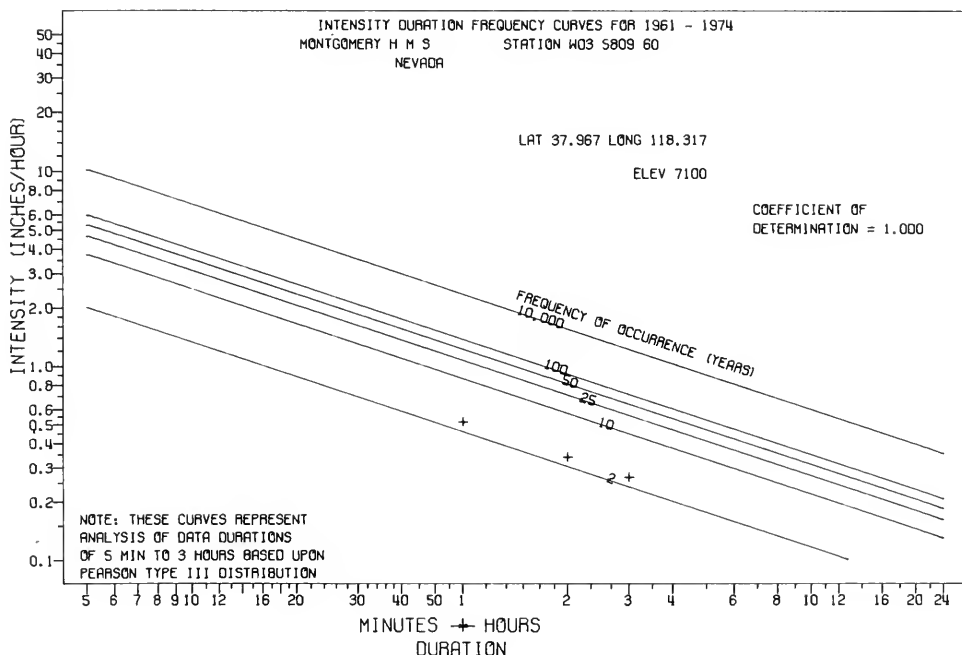
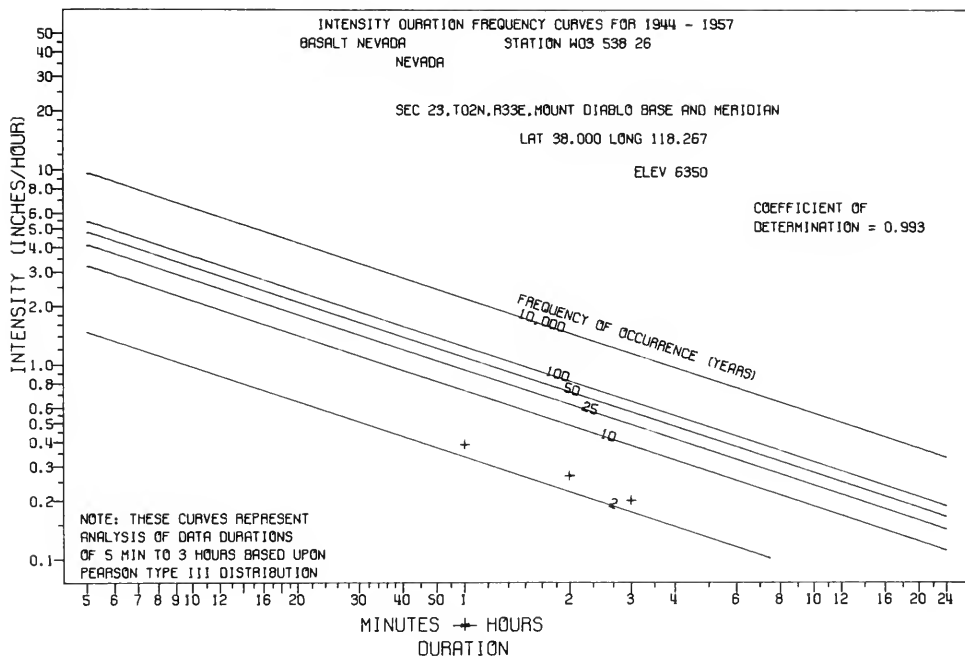


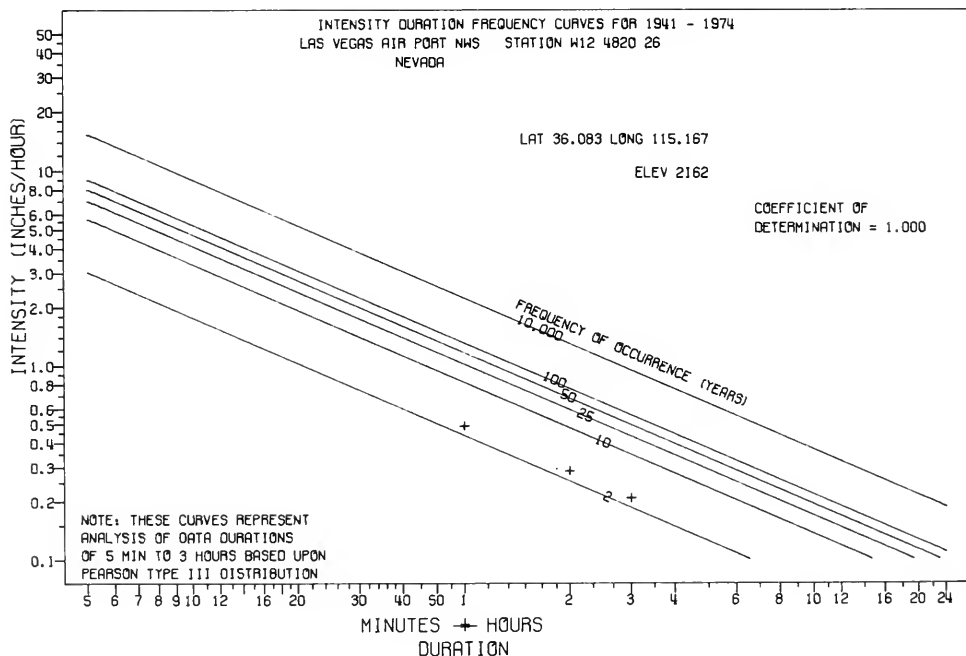
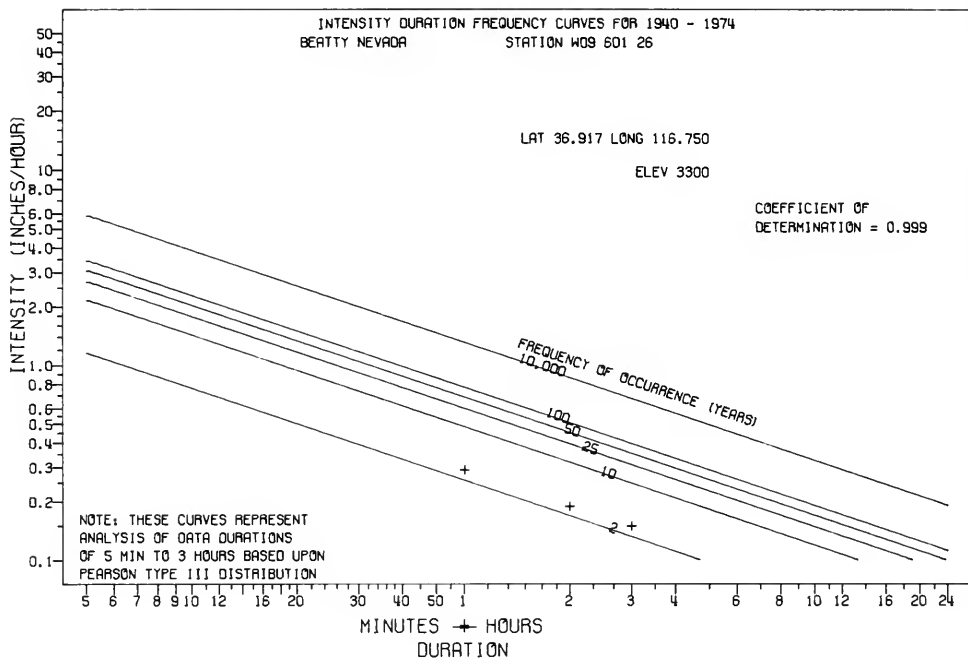












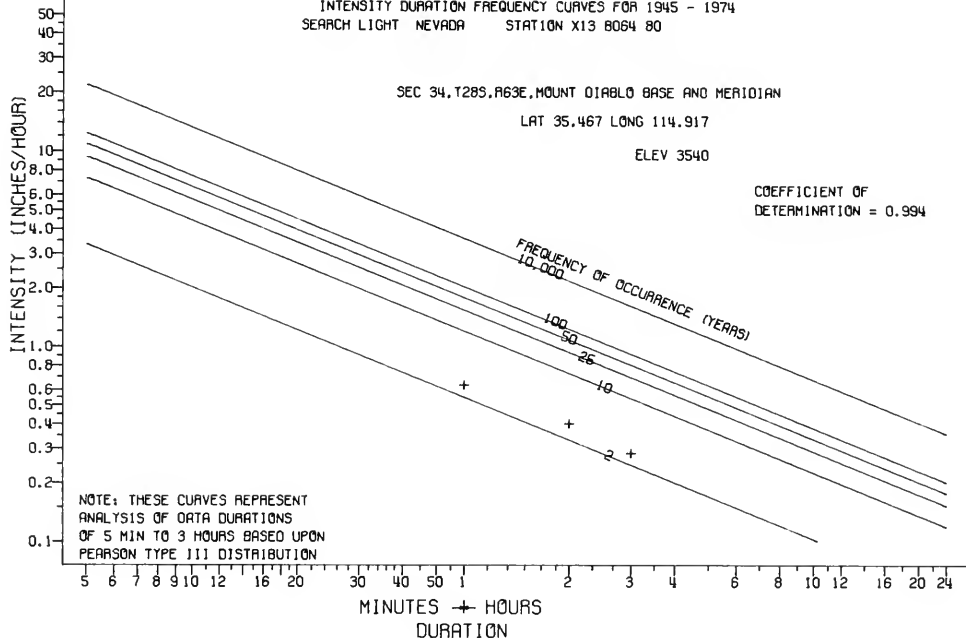
INTENSITY DURATION FREQUENCY CURVES FOR 1945 - 1974
SEARCH LIGHT NEVADA STATION X13 8084 80

SEC 34, T28S, R63E, MOUNT DIABLO BASE AND MERIDIAN

LAT 35.467 LONG 114.917

ELEV 3540

COEFFICIENT OF
DETERMINATION = 0.994



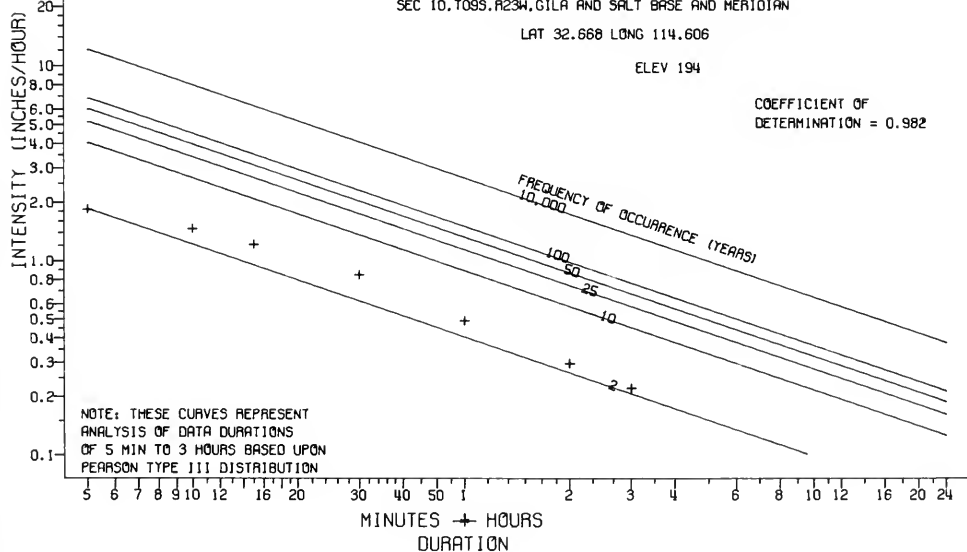
INTENSITY DURATION FREQUENCY CURVES FOR 1941 - 1975
YUMA ARIZONA AP NWS STATION X27 9890 2

SEC 10, T08S, R23W, GILA AND SALT BASE AND MERIDIAN

LAT 32.668 LONG 114.606

ELEV 194

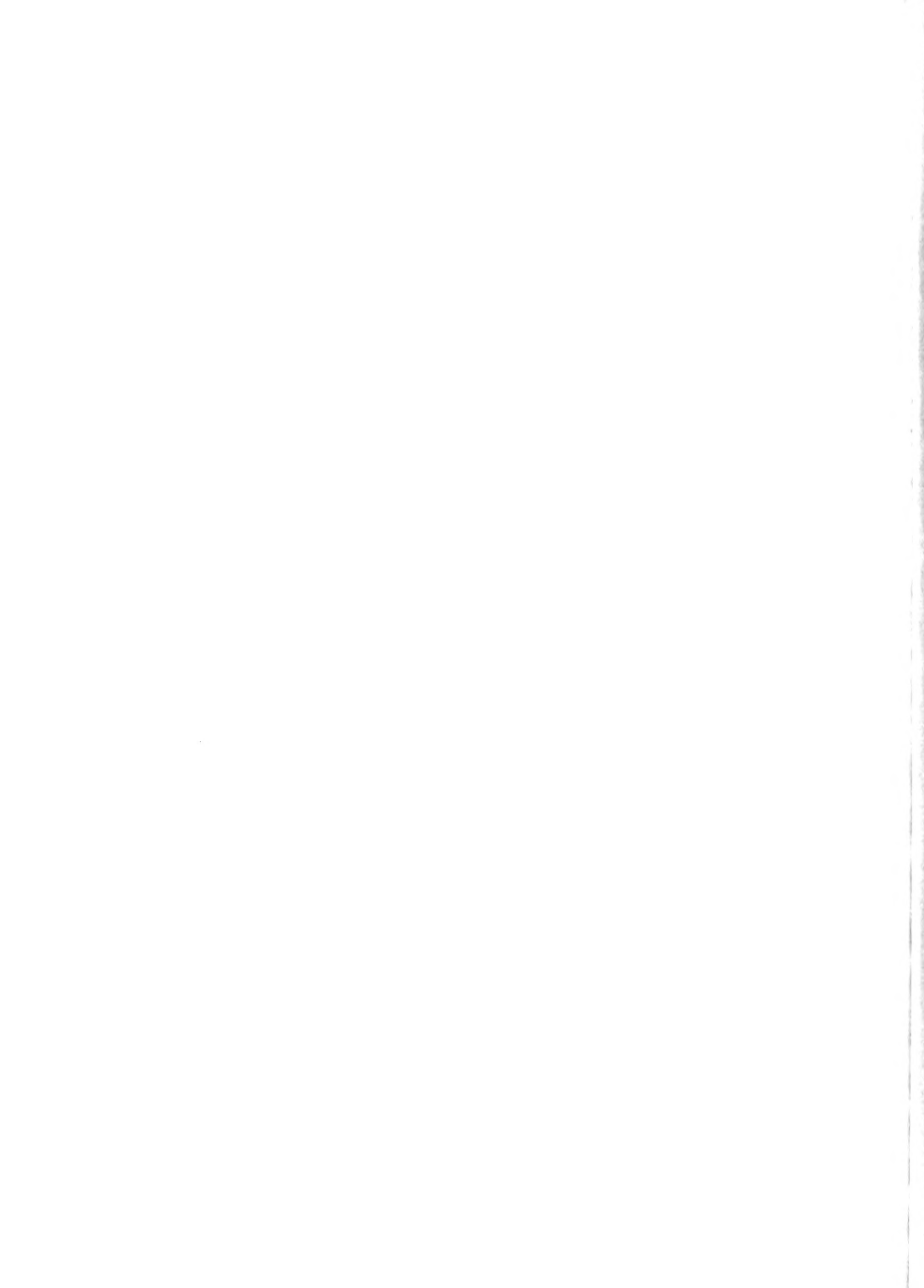
COEFFICIENT OF
DETERMINATION = 0.982



CONVERSION FACTORS

English to Metric System of Measurement

<u>Quantity</u>	<u>English unit</u>	<u>Multiply by</u>	<u>To get metric equivalent</u>
Length	inches (in)	25.4	millimetres (mm)
		.0254	metres (m)
	feet (ft)	.3048	metres (m)
	miles (mi)	1.6093	kilometres (km)
Area	square inches (in ²)	6.4516×10^{-4}	square metres (m ²)
	square feet (ft ²)	.092903	square metres (m ²)
	acres	4046.9	square metres (m ²)
		.40469	hectares (ha)
		.40469	square hectometres (hm ²)
		.0040469	square kilometres (km ²)
	square miles (mi ²)	2.590	square kilometres (km ²)
Volume	gallons (gal)	3.7854	litres (l)
		.0037854	cubic metres (m ³)
	million gallons (10 ⁶ gal)	3785.4	cubic metres (m ³)
	cubic feet (ft ³)	.028317	cubic metres (m ³)
	cubic yards (yd ³)	.76455	cubic metres (m ³)
	acre-feet (ac-ft)	1233.5	cubic metres (m ³)
		.0012335	cubic hectometres (hm ³)
		1.233×10^{-6}	cubic kilometres (km ³)
Volume/Time			
(Flow)	cubic feet per second (ft ³ /s)	28.317	litres per second (l/s)
		.028317	cubic metres per second (m ³ /s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
		6.309×10^{-5}	cubic metres per second (m ³ /s)
	million gallons per day (mgd)	.043813	cubic metres per second (m ³ /s)
Mass	pounds (lb)	.45359	kilograms (kg)
	tons (short, 2,000 lb)	.90718	tonne (t)
		907.18	kilograms (kg)
Power	horsepower (hp)	0.7460	kilowatts (kW)
Pressure	pounds per square inch (psi)	6894.8	pascal (Pa)
Temperature	Degrees Fahrenheit (°F)	$\frac{t_F - 32}{1.8} = t_C$	Degrees Celsius (°C)



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